

DEPARTMENT OF WATER AND SANITATION

NO. 1559

3 December 2021

**NATIONAL WATER ACT, 1998
(ACT NO. 36 OF 1998)****RESERVE DETERMINATION FOR WATER RESOURCES OF THE CROCODILE WEST AND
MARICO CATCHMENTS IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER
ACT, 1998 (ACT NO. 36 OF 1998)**

I Senzo Mchunu, in my capacity as Minister of Water and Sanitation, having complied with section 13 of the National Water Act, 1998 (Act No. 36 of 1998) ("the Act"), and Regulation 3 of the Regulations for the Establishment of Water Resource Classification System (No. R. 810 *Gazette* No. 33541, 17 September 2010), and duly authorised in terms of sections 16(1) and 63(1)(a) of the Act, after having complied with section 16(2) and (3) of the Act, hereby publish the Reserve determination for water resources of the Crocodile West and Marico catchments.

Director: Reserve Determination
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SENZO MCHUNU (MP)
MINISTER OF WATER AND SANITATION

DATE: 13/10/2021

SCHEDULE

RESERVE DETERMINATION OF WATER RESOURCES FOR THE CROCODILE WEST AND MARICO CATCHMENTS IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

1. ACRONYMS AND DEFINITIONS

1.1. List of Acronyms

ASPT	Average Score Per Taxon
BHN	Basic Human Needs
CEV	Chronic Effects Value
DWA	Department of Water Affairs
DWAF	Department of Water and Forestry
DWS	Department of Water and Sanitation
EcoSpecs	Ecological Specifications
EIS	Ecological Importance and Sensitivity
EWR	Ecological Water Requirements
FRAI	Fish Response Assessment Index
GRDM	Groundwater Reserve Determination Methodology
GW	Ground Water
HN	Hydro-Node
MCM	Million Cubic Metres
MLF	Maintenance Low Flow
NMAR	Natural Mean Annual Runoff
NTU	Nephelometric Turbidity Units
PAI	Physico-chemical Driver Assessment Index
PES	Present Ecological Status
RC	Reference Condition
REC	Recommended Ecological Category
RHP	River Health Programme
SRP	Soluble Reactive Ortho-Phosphorus
TIN	Total Inorganic Nitrogen
TPCs	Thresholds of Potential Concern
WMS	Water Management System
WRC	Water Research Commission
WQ	Water Quality
WQSU	Water Quality Subunits

1.2. Definitions

In this Schedule any word to which a meaning has been assigned in the National Water Act shall bear the meaning so assigned and, unless the context otherwise indicates -

“Baseflow” is a sustained low flow in rivers during dry or fair weather conditions, but not necessarily all contributed by groundwater; and includes contribution from delayed interflow and groundwater discharge;

“Class of a Water Resource” means a set of desired characteristics for use and ecological condition for significant water resources in a given catchment (integrated unit of analysis). The Class must describe the extent of use of the water resource; the Reserve; the resource quality objectives and the determination of the allocable portion of the water resource for use. Water resources must be classified into one of the three classes, Class I water resource Class II water resource and Class III water resource;

“Ecological Category” means the ecological condition to a water resource that reflects the deviation of the biophysical components of the water resource from the natural reference condition;

“Ecological Importance and Sensitivity” (EIS) means key indicators in the ecological categorisation of water resources. Ecological importance relates to the presence, representativeness and diversity of species of biota and habitat. Ecological sensitivity relates to the vulnerability of the habitat and biota to modifications that may occur in flows, water levels and physico-chemical conditions;

“Ecological Water Requirement” (EWR) means the flow patterns (the magnitude, timing and duration thereof) and the water quality needed to maintain a riverine ecosystem in a particular condition and refers to both the quantity and quality components of a riverine ecosystem;

“EWR Sites” means specific points on the river as determined through the site selection process. An EWR site consists of a length of river which may consist of various cross-sections for both hydraulic and ecological purposes. These sites provide sufficient indicators to assess environmental flows and assess the condition of biophysical components (drivers such as hydrology, geomorphology and physico-chemical) and biological responses (viz. fish, invertebrates and riparian vegetation);

“Recharge” means the addition of water to the zone of saturation, either by downward percolation of precipitation or surface water and/ or the lateral migration of groundwater from adjacent aquifers;

“Recommended Ecological Category” (REC) means an ecological category indicating the ecological management target for a water resource based on its ecological classification that should be attained. Categories range from Category A (unmodified, natural) to Category D (largely modified);

“Reserve” means the quantity and quality of the water required to satisfy the basic human needs by securing a basic water supply and to protect the aquatic ecosystem in order to secure ecologically sustainable development and use of the relevant water resource;

“River Node” (biophysical node) means modelling points representative of an upstream reach or area of an aquatic eco-system (rivers, wetlands, estuaries and groundwater) for which a suite of relationships apply.

2. DESCRIPTION OF WATER RESOURCE

2.1 The Reserve is determined for all or part of every significant water resource within the catchments of the Crocodile (West) and Marico, as set out below:

Water Management Area:	Limpopo
Drainage Region:	A21 to A24, A31 & A32 Tertiary Drainage Region
River(s):	Crocodile (West) and Marico river systems

2.2 The Minister has in terms of section 12 of the National Water Act, 1998 (Act No.36 of 1998) ("the Act"), prescribed a system for classifying water resources by issuing Government Notice No. R. 810, published in Government Gazette No. 33541 dated 17 September 2010. In terms of section 16(1) of the Act, the Minister must, as soon as reasonably practicable after the class of all or part of a water resource has been determined, by Notice in the Gazette, determine the reserve for all or part of that water resource.

2.3 The Minister, in terms of section 16(1) and (2) of the Act, declares the following Reserves for the Crocodile West and Marico catchments.

3. PROPOSED RESERVE DETERMINATION AS REQUIRED IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998

A summary of the quantity component for the Rivers which include the EWR (**Figure 1**) and the BHN in terms of section 16(1) of the Act for the Crocodile (West) and Marico catchment is set out in Section 4. **Table 4.1& 4.2** includes the results of the EWR sites and the biophysical nodes;

A summary of the quality component for the River at EWR sites in terms of section 16(1) of the Act for the Crocodile (West) and Marico catchments is set out in **Table 5.1-5.24**;

A summary of the groundwater contribution to the Reserve for Water Quantity in terms of section 16(1) of the Act for the Crocodile (West) and Marico catchment is set out in **Table 6.1**;

A summary of the groundwater contribution to the Reserve for Water Quality in terms of section 16(1) of the Act for the Crocodile (West) and Marico catchment is set out in **Table 7.1, 7.2 and 7.3**;

The Reserve will apply from the date signed off as determined in terms of Section 16(1) of the Act, unless otherwise specified by the Minister.

4. SURFACE-WATER - QUANTITY COMPONENT FOR RIVERS

Proposed results for the Reserve determination and ecological categorisation for the Crocodile (West) and Marico catchment, where the Reserve amounts are expressed as a percentage of the NMAR for the respective catchments (cumulative) in terms of section (16)(1).

Table 4.1: Summary of the quantity component for the Rivers which include the EWR & BHN for the priority sites.

Node Name	Quaternary Catchment	River Name	PES	EIS	Recommended Ecological Category to be maintained	NIMAR (MCM) ¹	EWR % NIMAR ²	BHN Reserve ³ (%NIMAR)	Total Reserve ⁴ (%NIMAR)
EWR site Croc_EWR1	A21 H	Crocodile River from Jukstei confluence to inflow Hartbeespoort Dam	D	Moderate	D	231.05	24.07	0.17	24.24
EWR site Croc_EWR2	A21C	Jukskei River	E	Moderate	D	139.9	29.19	3.55	32.74
EWR site Croc_EWR3	A21J	Crocodile from Hartbeespoort Dam to upstream Roodekopjes Dam	C/D	High	C/D	143.3	25.02	0.84	25.87
EWR site Croc_EWR4	A23B	Pienaars from Rodeeplaas Dam to outlet of quaternary catchment	C	High	C	28.2	30.81	1.18	31.99
EWR Site Croc_EWR5	A23J	Moretele (Pienaars) to confluence with Crocodile	D	High	D	113.0	11.82	5.23	17.05
EWR site Croc_EWR6	A22J	Hex from Bospoort Dam to inflow Vaalkop Dam	D	Moderate	D	26.9	14.96	1.35	16.31
EWR Sites Croc_EWR7	A24C	Crocodile River outflow Roodekopjes Dam to upstream Sand River confluence, Sleepfontein-spruit, Klipspruit tributaries	D	Moderate	D	463.4	13.9	0	13.9
EWR Site Croc_EWR8	A24J	Lower Crocodile from Bierspruit confluence to confluence with Limpopo	D	Moderate	D	565.16	7.48	0.09	7.57
Croc Rapid EWR9	A21F	Magalies below Maloney's Eye	B	Moderate	B	14.61	45.93	0.58	46.51
Croc Rapid_EWR10	A22A	Upper reaches of Elands (source) to Swartuggens Dam	C	Moderate	B/C	10.1	30.48	3.66	34.14
Croc Rapid_EWR11	A21K	Upper reaches of Sterkstroom (source) to inflow Buffelspoort Dam	C	High	C	13.95	28.41	5.76	34.17
Croc Rapid_EWR12	A23G	Plat River	C/D	Moderate	C/D	4.864	23.08	14.20	37.28
Croc Rapid_EWR13	A22E	Elands from Lindleyspoort Dam to Vaalkop Dam	C	Low	C	18.77	21.90	0.312	22.21
Croc Rapid_EWR14	A22H	Waterkloofspruit to confluence with Hex	B/C	Low	B/C	5.469	28.27	38.44	66.71
Croc Rapid EWR15	A21F	Magalies, Klein Magalies, Bloubank	C/D	Low	C/D	21.89	21.18	0.39	21.57
Croc Rapid EWR_16	A21A	Rietvlei (source)	C	Low	C	4.788	27.83	28.865	56.69
EWR site Mar_EWR1	A31A	Marico Eye, Kaaloog-se-Loop, Bokkraal-se-Loop, Ribbokfontein-se-Loop, Rietfontein (southern eye), Kulisfontein, Syferfontein, Bronkhorstfontein	B	Very high	B	10.539	76.32	0	76.32
EWR Site Mar_EWR2	A31B	Groot Marico main stem upstream to Polkadraaispruit confluence	B	Very high	B	42.08	50.26	0.03	50.29
EWR Site Mar_EWR3	A31F	Marico Groot Marico from outflow Marico Bosveld Dam to Molatedi Dam, all tributaries	C/D	High	C/D	65.083	23.62	0.33	23.95

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Node Name	Quaternary Catchment	River Name	PES	EIS	Recommended Ecological Category to be maintained	NIMAR (MCM) ¹⁾	EWR % NIMAR ²⁾	BHN Reserve ³⁾ (%NIMAR)	Total Reserve ⁴⁾ (%NIMAR)
EWR Site Mar_EWR4	A32D	Marico from Molatedi Dam to confluence with Limpopo, Rasweu, Maselate rivers	C	High	C	153.25	7.96	0.01	7.97
EWR Site Mar_EWR5	A31E	Klein Marico from Klein Maricopoort Dam to Krommellembog Dam	C	Moderate	C	16.25	11.70	0.05	11.75
Mar Rapid_EWR6	A31B	Polkadraaispruit to confluence with Marico	B/C	Moderate	B	9.87	49.27	0.13	49.39

1) NIMAR is the Natural Mean Annual Runoff.

2) This amount represents the long term mean based on the NIMAR. If the NIMAR changes, this volume will also change.

3) Represents the percentage of BHN.

4) The total Reserve amount accounts for both the Ecological Reserve and the Basic Human Needs Reserve (BHN).

Table 4.2: Summary of the quantity component for the hydronodes sites which include the EWR & BHN

Node Name	Quaternary Catchment	River Name	PES	EIS	Recommended Ecological Category to be maintained	NIMAR (MCM) ¹⁾	EWR % NIMAR ²⁾	BHN Reserve ³⁾ (%NIMAR)	Total Reserve ⁴⁾ (%NIMAR)
HN1	A21A	Hennops River upstream Rietvlei Dam	C	Low	C	11.66	27.83	11.84	39.67
HN25	A22H	Hex from Olifantsnek Dam to Bospoort Dam, Sandspuit	D	Moderate	D	12.11	15.26	17.36	32.62
HN29	A22A	Elands from Swarttuggens Dam to Lindleyspoort Dam	C	High	C	12.87	23.99	2.88	26.87
HN30	A22B	Upper Koster (source) to Koster Dam	C	High	C	2.54	22.77	15.19	37.97
EWR Site Mar_EWR2	A31B	Groot Marico main stem upstream to Polkadraaispruit confluence	B	Very high	B	42.08	50.26	0.03	50.29
HN63	A31B	Groot Marico from Polkadraaispruit confluence to Marico Bosveld Dam	B	Very high	B	56.92	50.61	0.02	50.63
HN65	A31E	Klein Marico from Zeerust to Klein Maricopoort Dam	C/D	Moderate	C/D	16.25	14.26	0.05	14.31
HN43	A24H	Sand to confluence with Crocodile	B	High	B	26.56	27.04	1.93	28.97

1) NIMAR is the Natural Mean Annual Runoff.

2) This amount represents the long term mean based on the NIMAR. If the NIMAR changes, this volume will also change.

3) Represents the percentage of BHN.

4) The total Reserve amount accounts for both the Ecological Reserve and the Basic Human Needs Reserve (BHN).

5. SUMMARY OF SURFACE WATER QUALITY COMPONENT FOR RIVERS AT EWR SITES

EWR 1: A21H-CROCODILE RIVER, Upstream of the Hartbeespoort Dam

Table 5.1: PES categories and overall site assessment for EWR Site 1

River	Crocodile River	DWA Water Quality Monitoring points	Category/Comment
WQSU	3	A2H013 Magalies River at Scheerpoort 2002-2007 (n=205)	F(5)
EWR Site	EWR1	A2H012 at Kalkheuwel on Crocodile River 2004-2008 (n=118)	A(0)
Water Quality Constituents		Value	Category/Comment
Inorganic Salts (mg/L)	MgSO ₄	72.755	F(5)
	Na ₂ SO ₄	13.465	A(0)
	MgCl ₂	1.368	A(0)
	CaCl ₂	15.198	A(0)
	NaCl	109.399	B(1)
Nutrients (mg/L)	PO ₄	0.610	E(4)
	TIN	4.848	E(4)
Physical variables	pH (pH units)	7.4-8.3	B(1)
	Temperature(°C)	16 (Single measurement)	Raised due to sewage/sealed surfaces
Response variable	Dissolved oxygen (mg/L)	6.3	C(2)Riffles covered
	Electrical Conductivity (mS/m)	66.56	C(2)
	Chl-a: periphyton (mg/m ²)	-	D High algal concentrations
	Biotic community composition - macro-invertebrates (ASPT) score	4.07 – 4.25	E
	Fish score (FRAI)	44.5	D
Toxics	In-stream toxicity	Weekly from waste water works, high in organics	
Overall site ecological category (from PAI model)	Ammonia(mg/L)	32	B(1)
		D	

Table 5.2: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 1: Upstream of the Hartbeespoort Dam

RIVER	WATER QUALITY MONITORING POINTS					
	Crocodile (West) River	A2H012 Crocodile River at Kalkheuwel				
WQSU	3	DWAQWQMS				
EWR SITE	EWR1	RHP				
Confidence in PES assessment						
	Medium	Currently several monitoring sites				
Water Quality constituents						
Inorganic salts (mg/L)	PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency	
	MgSO ₄	>45mg/L		95 th percentile to be <45mg/L		
	Na ₂ SO ₄	<20mg/L		95 th percentile to be <20mg/L		
	MgCl ₂	<15mg/L	N/A	95 th percentile to be <15mg/L	Monthly	
	CaCl ₂	<21mg/L		95 th percentile to be <21mg/L		
Nutrients (mg/L)	NaCl	<191mg/L		95 th percentile to be <191mg/L		
	SRP	<0.125mg/L	Yes, to D	5 th percentile to be <0.125mg/L	Monthly	
	TIN	<4.0mg/L	Yes, to D	50 th percentile to be <4.0mg/L	Monthly	
Physical Variables	pH	Neutral river	No	5 th percentile (5.9-6.5) 95 th percentile (8.0-8.8)	Monthly	
	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	N/A	Initiate baseline monitoring for this variable.	When Biotic assessments undertaken	
	Dissolved oxygen		N/A	5 th percentile to be >6.1mg/L. Initiate Baseline monitoring for this variable.		
	Turbidity (NTU)	Turbid after heavy rains.	N/A	Initiate baseline monitoring for this variable and maintain natural range.	Quarterly	
	Electrical conductivity (mS/m)	Category=C.	<85mS/m	No	95 th percentile to be <85mS/m	Quarterly
Response variables	Chla: periphyton	Category=D. Visual inspection indicates high algal concentrations on rocks and in pools	N/A	50 th percentile to be <84mg/m ²	Quarterly	
	Chla: phytoplankton			50 th percentile to be <30µg/L (D category)		
	Macro-invertebrates (ASPT)	E (this study)		See Ecospecs for fish and invertebrates respectively		
	Fish community score	D (this study)				
Toxics	Ammonia	B		<43.7µg/L	95 th percentile to be <43.7µg/L	Monthly

EWR 2: A21C-JUKSKEI RIVER at Heron Bridge School

Table 5.3: PES categories and overall site assessment for EWR site 2

River	Jukskei River	DWAF Water Quality Monitoring points	Category/Comment
WQSU	1	RC A2H013 Magalies River at Scheerpoort 2002-2007 (n=205)	F(5)
EWR Site	EWR2	PES A2H023 Jukskei River at Nietgedacht 2004-2008 (n=114)	B(1)
Water Quality Constituents		Value	Category/Comment
Inorganic (mg/L)	MgSO ₄	71.494	F(5)
	Na ₂ SO ₄	26.244	B(1)
	MgCl ₂	0.312	A(0)
	CaCl ₂	20.236	A(0)
Nutrients(mg/L)	NaCl	96.146	B(1)
	PO ₄	0.266	E(4)
	TIN	5.460	E(4)
Physical variables	pH (pH units)	7.1-8.1	B(1)
	Temperature (° C)	Raised temperatures from waste water treatment ponds	D
Response variable	Dissolved oxygen (mg/L)	-	D
	Electrical Conductivity (mS/m)	63	C(2)
	Chl-a: periphyton (mg/m ²)	14.41	D(1)
	Biotic community composition - macro-invertebrate (ASPT) score	3.8- 4.0	E/F
Toxics	Fish score	21.4%	E/F
Overall site ecological category (PAI model)	In-stream toxicity	-	
	Ammonia (µg/L)	80	D(3)
		D	

Table 5.4: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 2: Jukskei River at Heron Bridge School

RIVER		WATER QUALITY MONITORING POINTS	
WQSU	Jukskei River	DWAWQWMS	A2H023 Juskei River at Nietgedacht
EWR SITE	EWR2	RHP	Currently several monitoring sites
Confidence in PES assessment			
	Medium		
Water Quality constituents			
	PES Category	WQ Ecospecs	Improvement required?
Inorganic salts (mg/L)		<45mg/L	
		<33mg/L	
		<15mg/L	N/A
		<21mg/L	
Nutrients (mg/L)		<191mg/L	
	SRP	<0.125mg/L	Yes, to D
	TIN	<4.0mg/L	Yes, to D
Physical Variables		5 th percentile(5.9-6.5)95 th percentile (8.0-8.8)	Yes, to natural
	pH	Good	
	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	N/A
	Dissolved oxygen		N/A
	Turbidity (NTU)	Turbid after heavy rains.	N/A
	Electrical conductivity (mS/m)	Category=C.	Moderate change Allowed
	Chla: periphyton	Category=C.	<85mS/m
	Chla: phytoplankton	Visual inspection indicates high algal concentrations on rocks and in pools	<84mg/m ² (D category)
	Macro-invertebrates (ASPT)	E/F (this study)	<15µg/L (D category)
	Fish community score	E/F (this study)	
Response variables		See Ecospecs for fish and invertebrates respectively	
	In-stream toxicity	Some toxicity from industry and waste water treatment works	Assess only if the bio-monitoring results indicate there is a serious problem and the cause is unknown. An impact is expected if the 95 th percentile of the data exceeds the Chronic Effects Value (CEV) as stated in DWAF (1996).
Toxics	Ammonia	<100µg/L	95 th percentile to be<100µg/L
			Monthly

EWR 3: A21J-CROCODILE RIVER, Downstream of the Hartbeespoort Dam

Table 5.5: PES categories and overall site assessment for EWR site 3

River	Crocodile River	DWAF Water Quality Monitoring points	Category/Comment
WGSU	5	RC A2H013 Magalies River at Scheerpoort 2002-2007 (n=205)	F(5)
EWR Site	EWR3	PES A2H083 Hartbeespoort Dam:d/sWeir2004-2008 (n=113)	A(0)
WaterQuality Constituents			
Inorganic salts (mg/L)	MgSO ₄	67.562	A(0)
	Na ₂ SO ₄	9.867	A(0)
	MgCl ₂	6.856	B(1)
	CaCl ₂	27.569	B(1)
	NaCl	96.462	E(4)
Nutrients(mg/L)	PO ₄	0.123	B(1)
	TIN	1.594	B(1)
Physical variables	pH (pH units)	7.51-8.73	C(2)
	Temperature (°C)	2 data points	C/D
	Dissolved oxygen (mg/L)	2 data points	C(2)
Response variable	Electrical Conductivity (mS/m)	59.24	E
	Chl-a: periphyton (mg/m ²)	Visual observations	E
	Biotic community composition -macro-invertebrates (ASPT) score	3.8	E
Toxics	Fish score	24.9	E
	In-stream toxicity	-	E(4)
Overall site ecological category	Ammonia (mg/L)	139	
		D/E	

Table 5.6: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 3: Crocodile River downstream of the Hartbeespoort Dam

RIVER		WATER QUALITY MONITORING POINTS				
Crocodyle (West) River		DWAWQWMS	A2H083 Hartbeespoort Dam downstream weir			
5		RHP	Currently several monitoring sites			
EWR SITE		EWR3				
Confidence in PES assessment		Medium				
Water Quality constituents		PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency
Inorganic salts (mg/L)	MgSO ₄		<45mg/L		95 th percentile to be <45mg/L	
	Na ₂ SO ₄		<20mg/L		95 th percentile to be <20mg/L	
	MgCl ₂		<15mg/L	N/A	95 th percentile to be <15mg/L	Monthly
	CaCl ₂		<57mg/L		95 th percentile to be <57mg/L	
	NaCl		<191mg/L		95 th percentile to be <191mg/L	
Nutrients (mg/L)	SRP	Category=E	<0.125mg/L	Yes, to D	50 th percentile to be <0.125mg/L	Monthly
	TIN	Category=D	<4.0mg/L	Yes, to D	50 th percentile to be <4.0mg/L	Monthly
Physical Variables	pH	Good	5 th percentile(5.9-6.5)95 th percentile (8.0-8.8)	Yes, to natural	5 th percentile(5.9-6.5)95 th percentile(8.0-8.8)	Monthly
	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	Maintain range	N/A	Site is downstream from a dam which will result in fluctuations in temperature and possible biotic responses. Biological assessments recommended. Initiate baseline monitoring.	When Biotic assessments undertaken
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be >6.1mg/L. Initiate Baseline monitoring for this variable.	
	Turbidity (NTU)	Turbid after heavy rains.	Moderate change allowed	N/A	Initiate baseline monitoring for this variable. Variable and maintain natural range.	Quarterly
	Electrical conductivity (mS/m)	Category=C.	<85mS/m	No	95 th percentile to be <85mS/m	Quarterly
	Chla: periphyton	Category =C. Visual inspection indicates high algal concentrations on rocks and in pools	<84mg/m ² (D category)	N/A	50 th percentile to be <84mg/m ²	Quarterly
	Chla: phytoplankton		<30µg/L (D category)	N/A	50 th percentile to be <30µg/L	Quarterly
	Macro-invertebrates (ASPT)	E (this study)	See Ecospecs for fish and invertebrates respectively			
	In-stream toxicity	Some toxicity from industry and waste water treatment works	Assess only if the bio-monitoring results indicate there is a serious problem and the cause is unknown. An impact is expected if the 95 th percentile of the data exceeds the Chronic Effects Value (CEV) as stated in DWAF (1996).			
	Toxics	Ammonia	E	<129µg/L		95 th percentile to be <129µg/L

EWR 4: A23B-PIENAARS RIVER, Downstream of the Roodeplaat Dam

Table 5.7: PES categories and overall site assessment for EWR site 4

River	Pienaars River	DWA Water Quality Monitoring points	Category/Comment
WQSU	15	RC A2H013 Magalies River at Scheerpoort 2002-2007 (n=205)	F(5)
EWR Site	EWR4	PES A2H006 Pienaars River at Klipdrift 2004-2008 (n=118)	A(0)
Water Quality Constituents		Value	Category/Comment
Inorganic salts (mg/L)			
	MgSO ₄	51.250	F(5)
	Na ₂ SO ₄	5.120	A(0)
	MgCl ₂	3.704	A(0)
	CaCl ₂	14.856	A(0)
	NaCl	81.789	B(1)
	PO ₄	0.049	B(1)
	TIN	0.442	A(0)
Physical variables			
	pH (pH units)	7.8-8.4	B(1)
	Temperature (°C)	1 data point	B(1) C(2)
	Dissolved oxygen (mg/L)	5.5 (2 data points)	
	Electrical Conductivity (mS/m)	57.1	C(2)
Response variable			
	Chl-a; periphyton (mg/m ²)	-	Visual observations
	Biotic community Composition macro-invertebrates (ASPT) score	5.8	C(2)
	Fish score	65.4%	C(2)
Toxics			
	In-stream toxicity	-	
	Ammonia (µg/L)	20	A(0)
Overall site ecological category		C	

Table 5.8: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 4: Pienaars River downstream of the Roodeplaat Dam

RIVER		WATER QUALITY MONITORING POINTS					
Pienaars River		DWAQWMS	A2H006 Pienaars at Klipdrift weir				
WGSU		RHP					
EWR SITE		Currently several monitoring sites					
Confidence in PES assessment		Medium					
Water Quality constituents		PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency	
Inorganic salts (mg/L)	MgSO ₄		<45mg/L		95 th percentile to be <45mg/L		
	Na ₂ SO ₄		<20mg/L		95 th percentile to be <20mg/L		
	MgCl ₂		<15mg/L	N/A	95 th percentile to be <15mg/L	Monthly	
	CaCl ₂		<21mg/L		95 th percentile to be <21mg/L		
	NaCl		<191mg/L		95 th percentile to be <191mg/L		
Nutrients (mg/L)	SRP	Category=B	<0.015mg/L		50 th percentile to be <0.15mg/L	Monthly	
	TIN	Category=B	<0.25mg/L		50 th percentile to be <0.25mg/L	Monthly	
Physical Variables	pH	Category=B, Good	5 th percentile(5.9-6.5)95 th percentile (8.0-8.8)	Yes, to natural	5 th percentile(5.9-6.5)95 th percentile(8.0-8.8)	Monthly	
	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	Maintain range	N/A	Site is downstream from a dam which will result in fluctuations in temperature and possible biotic response. Biological assessments recommended. Initiate baseline monitoring.	When Biotic assessments undertaken	
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be >6.1mg/L. Initiate Baseline monitoring for this variable.		
	Turbidity (NTU)	Turbid after heavy rains.	Moderate change Allowed	N/A	N/A	Initiate baseline monitoring for this variable and maintain natural range.	Quarterly
	Electrical conductivity (mS/m)	Category=C	<85mS/m	No	N/A	95 th percentile to be <85mS/m	Quarterly
Response variables	Chla: periphyton	Category =C. Visual inspection indicates high algal concentrations on rocks and in pools	<84mg/m ² (D category)	N/A	50 th percentile to be <84mg/m ²	Quarterly	
	Macro-invertebrates (ASPT)	C (this study)	<30µg/L (D category)		50 th percentile to be <30µg/L		
	In-stream toxicity	Some toxicity from industry and waste water treatment works	See Ecospecs for fish and invertebrates respectively		Assess only if the biomonitoring results indicate there is a serious problem and the cause is unknown. An impact is expected if the 95 th percentile of the data exceeds the Chronic Effects Value (CEV) as stated in DWAF (1996).		
Toxics	Ammonia	A	<15ug/L		95 th percentile to be <15ug/L	Monthly	

EWR 5: A23J-PIENAARS RIVER, Downstream of the Klipvoor Dam in Borakalalo National Park

Table 5.9: PES categories and overall site assessment for EWR site 5

River	Plenaars River	DWA Water Quality Monitoring points	
WQSU	17	RC A2H013Magalies River at Scheerpoort	
EWR Site	EWR5	PES A2H021 Plenaars River at Buffelspoort	
		2004-2008($n=107$)	
Water Quality Constituents			
Inorganic salts(mg/L)	MgSO ₄	Value 78.335	Category/Comment F(5)
	Na ₂ SO ₄	16.527	A(0)
	MgCl ₂	3.820	A(0)
	CaCl ₂	24.153	B(1)
	NaCl	131.982	B(1)
Nutrients(mg/L)	PO ₄	0.598	B(1)
	TIN	0.250	A(0)
Physical variables	pH(pH units)	7.7-8.7	B(1)
	Temperature (° C)	16($n=1$)	Recovers from dam B
	Dissolved oxygen (mg/L)	5.2($n=1$)	
	Electrical Conductivity(mS/m)	80.8	C(2)
Response variable	Chl- <i>a</i> : periphyton (mg/m ²)	-	
	Biotic community composition - macro-invertebrate (ASPT) score	5.5	D
	Fish score (FRAI)	51.3%	D
	In-stream toxicity	-	
	Ammonia (µg/L)	47	B(1)
Toxics	Fluoride (µg/L)	600	A(0)
Overall site ecological category			C

Table 5.10: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 5: Pienaars River downstream of Klipvoor dam

RIVER		WATER QUALITY MONITORING POINTS				
WQSU	Pienaars River	DWA/WQWMS	A2H021 Pienaars River at Buffelspoort			
EWR SITE	EWR5	RHP	Currently several monitoring sites			
Confidence in PES assessments						
Water Quality constituents		PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency
Inorganic salts (mg/L)	MgSO ₄		<45mg/L		95 th percentile to be <45mg/L	Monthly
	Na ₂ SO ₄		<20mg/L		95 th percentile to be <20mg/L	
	MgCl ₂		<15mg/L	N/A	95 th percentile to be <15mg/L	
	CaCl ₂		<57mg/L		95 th percentile to be <57mg/L	
	NaCl		<191mg/L		95 th percentile to be <191mg/L	
Nutrients (mg/L)	SRP	Category=D	<0.015mg/L		50 th percentile to be <0.015mg/L	Monthly
	TIN	Category=B	<0.25mg/L		50 th percentile to be <0.25mg/L	Monthly
	pH	Category=B, Good	5 th percentile(5.9-6.5) 95 th percentile (8.0-8.8)	Yes, to natural	5 th percentile(5.9-6.5) 95 th percentile(8.0-8.8)	Monthly
Physical Variables	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	Maintain range	N/A	Site is downstream from a dam which will result in fluctuations in temperature and possible biotic response. Biological assessments recommended. Initiate baseline monitoring.	When Biotic assessments undertaken
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be >6.1mg/L. Initiate Baseline monitoring for this variable.	Quarterly
	Turbidity (NTU)	Turbid after heavy rains.	Moderate change allowed	N/A	Initiate baseline monitoring for this variable and maintain natural range.	
	Electrical conductivity (mS/m)	Category=C	<85mS/m	No	95 th percentile to be <85mS/m	
	Response variables	Chla: periphyton	Category=C. Visual inspection indicates high algal concentrations on rocks and in pools	<84mg/m (D ² category)	N/A	50 th percentile to be <84mg/m ²
Chla: phytoplankton			<30µg/L (D category)		50 th percentile to be <30µg/L	
Macro-invertebrates (ASPT)		D (this study)	See Ecospecs for fish and invertebrates respectively			
Toxics	Fish community score	D (this study)				Monthly
	In-stream toxicity	Some toxicity from industry and waste water treatment works				
	Ammonia	B	<43.75ug/L		95 th percentile to be <43.75ug/L	Monthly

EWR 6: A22J-HEX RIVER, Upstream of the Vaalkop Dam

Table 5.11: PES categories and overall site assessment for EWR site 6

River	Hex River	DWAF Water Quality Monitoring points	Category/Comment
WQSU	9	A2H013 Magalies River at Scheerpoort 2002-2007 (n=205)	F(5)
EWR Site	EWR6	A2H094BospoortDam d/s weir at Tweedepoort 1999-2004 (n=22) LOW confidence	A(0)
Water Quality Constituents		Value	Category/Comment
Inorganic salts(mg/L)		133.123	F(5)
MgSO ₄			
Na ₂ SO ₄			
MgCl ₂		33.113	C(2)
CaCl ₂		110.127	E(4)
NaCl		170.523	B(1)
PO ₄		0.234	E(4)
TIN		0.775	A(0)
pH(pHunits)		7.6-9.1	C(2)
Temperature(°C)		2 data points	C(2)
Dissolved oxygen (mg/L)		3 data points	D(3)
Electrical Conductivity (mS/m)		95.3	D(3)
Chl-a: periphyton (mg/m ²)		-	Visual observations
Biotic community composition- macro-invertebrate (ASPT) score		4.6	E
Fish score (FRAI)		49.1%	D
In-stream toxicity		-	
Ammonia (µg/L)		138	E(4)
Fluoride (µg/L)		300	A(0)
Overall site ecological category		D	

Table 5.12: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 6: Hex River upstream of the Vaalkop Dam

RIVER		WATER QUALITY MONITORING POINTS					
Hex River		DWA/QWMS	A2H094 Bospoort Dam downstream weir				
9		RHP	Currently several monitoring sites				
EWR SITE		EWR6					
Confidence in PES assessment		Medium					
Water Quality constituents		PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency	
Inorganic salts (mg/L)	MgSO ₄		<45mg/L		95 th percentile to be <45mg/L	Monthly	
	Na ₂ SO ₄		<20mg/L		95 th percentile to be <20mg/L		
	MgCl ₂		<36mg/L	N/A	95 th percentile to be <36mg/L		
	CaCl ₂		<141mg/L		95 th percentile to be <141mg/L		
	NaCl		<191mg/L		95 th percentile to be <191mg/L		
Nutrients (mg/L)	SRP	Category=E	<0.125mg/L	Yes, to D	50 th percentile to be <0.125mg/L	Monthly	
	TIN	Category=C	<0.25mg/L		50 th percentile to be <25mg/L	Monthly	
Physical Variables	pH	Category=C, moderate	5 th percentile (5.6-5.9) 95 th percentile (8.8-9.2)	Yes	5 th percentile (5.6-5.9) > 95 th percentile (8.8-9.2)	Monthly	
	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	Maintain range	N/A	Initiate baseline monitoring for this variable.	When Biotic assessments undertaken	
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be >6.7mg/L. Initiate baseline monitoring for this variable.		
	Turbidity (NTU)	Turbid after heavy rains.	Moderate change allowed		N/A	Initiate baseline monitoring for this variable and maintain natural range.	Quarterly
	Electrical conductivity (mS/m)	Category=D	<85mS/m	Yes, to C	95 th percentile to be <85mS/m	Quarterly	
Response variables	Chla: periphyton	Category =C. Visual inspection indicates high algal concentrations on rocks and in pools	<84mg/m (D ² category)	N/A	50 th percentile to be <84mg/m ²	Quarterly	
	Chla: phytoplankton		<30µg/L (D category)		50 th percentile to be <30µg/L		
	Macro-invertebrates (ASPT)	E (this study)	See Ecospecs for fish and invertebrates respectively				
Toxics	Fish community score	D (this study)					
	In-stream toxicity	Some toxicity from industry and waste water treatment works	Assess only if the biomonitoring results indicate there is a serious problem and the cause is unknown. An impact is expected if the 95 th percentile of the data exceeds the Chronic Effects Value (CEV) as stated in DWAF (1996).				
	Ammonia	E	<129µg/L	Yes to D	95 th percentile to be <129µg/L	Monthly	

EWR 7: A24C-CROCODILE RIVER, Upstream of the confluence with the Bierspruit River

Table 5.13: PES categories and overall site assessment for EWR site 7

River	Crocodile River	DWA Water Quality Monitoring points	Category/Comment
WQSU	21	RC A2H013 Magalies River at Scheerpoort 2004-2007 (n=205)	F(5)
EWR Site	EWR7	PES A2H060 Crocodile River at Nooitgedacht 2004-2008(n=113)	A(0)
Water Quality Constituents			
Inorganic salts (mg/L)	MgSO ₄	Value 112.138	A(0)
	Na ₂ SO ₄	12.102	A(0)
	MgCl ₂	1.507	A(0)
	CaCl ₂	20.658	A(0)
	NaCl	187.768	B(1)
Nutrients (mg/L)	PO ₄	0.243	E(4)
	TIN	0.302	A(0)
	pH(pH units)	7.8-8.5	B(1)
Physical variables	Temperature (° C)	Raised temp due to lower and shallower flows	D(3)
	Dissolved oxygen (mg/L)	As above	
	Electrical Conductivity (mS/m)	92.3	D(3)
Response variable	Chl-a: periphyton (mg/m ²)	-	Algal growth on sand (visual observation)
	Biotic community composition -macro-invertebrates (ASPT) score	4.6	C
	Fish score (FRAI)	46.2%	D
Toxics	In-stream toxicity	-	
Overall site ecological category	Ammonia (µg/L)	20	B (1)
		D	

Table 5.14: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 7: Crocodile River upstream of confluence with Bierspruit River

RIVER	Crocodile (West) River		WATER QUALITY MONITORING POINTS		Monitoring frequency	
	WQSU	21	DWAWQWMS	A2H060 Crocodile River at Nooitgedacht		
EWR SITE	EWR7		RHP	Currently several monitoring sites		
Confidence in PES assessment						
Water Quality constituents		PES Category	WQEcospecs	Improvement required?	TPC	
Inorganic salts (mg/L)	MgSO ₄		<45mg/L		95 th percentile to be <45mg/L	Monthly
	Na ₂ SO ₄		<20mg/L	N/A	95 th percentile to be <20mg/L	
	MgCl ₂		<15mg/L		95 th percentile to be <15mg/L	
	CaCl ₂		<21mg/L		95 th percentile to be <21mg/L	
	NaCl		<191 mg/L		95 th percentile to be <191mg/L	
Nutrients (mg/L)	SRP	Category=E	<0.125mg/L	Yes, to D	50 th percentile to be <0.125mg/L	Monthly
	TIN	Category=A	<0.25mg/L		50 th percentile to be <0.25mg/L	Monthly
Physical Variables	pH	Category=B, Good	5 th percentile(5.9-6.5) 95 th percentile (8.0-8.8)	N/A	5 th percentile (5.9-6.5) 95 th percentile (8.0-8.8)	Monthly
	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	Maintain range	N/A	Initiate baseline monitoring for this variable.	When assessments undertaken
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be >6.1mg/L. Initiate baseline monitoring for this variable.	Quarterly
	Turbidity (NTU)	Turbid after heavy rains.	Moderate change allowed	N/A	Initiate baseline monitoring for this variable and maintain natural range.	Quarterly
	Electrical conductivity (mS/m)	Category=D	<85mS/m	Yes, to C	95 th percentile to be <85mS/m	Quarterly
Response variables	Chla: periphyton	Category =C.	<84mg/m ² (D category)	N/A	50 th percentile to be <84mg/m ²	Quarterly
	Chla: phytoplankton	Visual inspection indicates high algal concentrations on rocks and in pools	<30µg/L (D category)		50 th percentile to be <30µg/L	
	Macro-invertebrates (ASPT)	E (this study)				
Toxics	Fish community score	D (this study)				
	In-stream toxicity	Some toxicity from industry and waste water treatment works				
	Ammonia	B	≤44µg/L	Yes to D	95 th percentile to be <44µg/L	Monthly

See Ecospecs for fish and invertebrates respectively

Assess only if the biomonitoring results indicate there is a serious problem and the cause is unknown. An impact is expected if the 95th percentile of the data exceeds the Chronic Effects Value (CEV) as stated in DWAF (1996).

EWR 8: A24J-CROCODILE RIVER, Downstream of the confluence with the Bierspruit River

Table 5.15: PES categories and overall site assessment for EWR site 8

River	Crocodile River	DWA Water Quality Monitoring points	
WQSU	24	RC A2H013 Magalies River at Scheerpoort 2002-2007 (n=205)	
EWR Site	EWR8	PES A2H116 Haakdoordriftd/s weir Paul Hugo Dam 2003-2008 (n=104)	
Water Quality Constituents		Value	Category/Comment
Inorganic salts (mg/L)		113.147	F(5)
MgSO ₄			
Na ₂ SO ₄		10.358	A(0)
MgCl ₂		2.622	A(0)
CaCl ₂		38.530	B(1)
NaCl		180.659	B(1)
PO ₄		0.107	D(3)
TIN		0.187	A(0)
pH (pH units)		7.7-8.6	B(1)
Temperature (°C)		1record	B(1)
Dissolved oxygen (mg/L)		1record	
Electrical Conductivity (mS/m)		91	D(3)
Chl-a: periphyton (mg/m ²)		-	Visual observation: no algae
Biotic community composition-macro-invertebrates (ASPT) score		4.39	C
Fish score (FRAI)		54.7%	C/D
In-stream toxicity		-	
Ammonia (µg/L)		25	B(1)
Overall site ecological category		C/D	

Table 5.16: Water quality specifications for the Reserve (Quality Ecospecs) at EWR 8: Crocodile River downstream of confluence with Bierspruit

RIVER	Crocodile(West)River		WATERQUALITYMONITORINGPOINTS			
	WQSU	24	DWAWQWMS	A2H116 Crocodile River at Haakdooringdrift downstream weir		
EWR SITE	EMR8	RHP	Currently several monitoring sites			
Confidence in PES assessment						
Water Quality constituents		PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency
Inorganic salts (mg/L)	MgSO ₄		<45mg/L		95 th percentile to be<45mg/L	
	Na ₂ SO ₄		<20mg/L		95 th percentile to be<20mg/L	
	MgCl ₂		<15mg/L	N/A	95 th percentile to be<15mg/L	Monthly
	CaCl ₂		<57mg/L		95 th percentile to be<57mg/L	
Nutrients (mg/L)	NaCl		<191mg/L		95 th percentile to be<191mg/L	
	SRP	Category=D	<0.125mg/L	Yes, to C	50 th percentile to be<0.125mg/L	Monthly
	TIN	Category=A	<0.25mg/L		50 th percentile to be<0.25mg/L	Monthly
Physical Variables	pH	Category=B, Good	5 th percentile(5.9-6.5) 95 th percentile (8.0-8.8)	N/A	3 rd percentile (5.9-6.5) 95 th percentile(8.0-8.8)	Monthly
	Temperature	Limited data and is impacted by waste water treatment works and urbanisation.	Maintain range	N/A	Initiate baseline monitoring for this variable.	When Biotic assessments undertaken
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be>6.1mg/L. Initiate baseline monitoring for this variable.	
	Turbidity (NTU)	Turbid after heavy rains.	Moderate change allowed	N/A	Initiate baseline monitoring for this variable and maintain natural range.	Quarterly
	Electrical conductivity (mS/m)	Category=D	<85mS/m	Yes, to C	95 th percentile to be<85mS/m	Quarterly
	Chla: periphyton	Category=C.	<84mg/m ²		50 th percentile to be<84mg/m ²	
	Chla: phytoplankton	Visual inspection indicates high algal concentrations on rocks and in pools	<30µg/L (D category)	N/A	50 th percentile to be<30µg/L	Quarterly
	Macro-invertebrates (ASPT)	E (this study)				
	Fish community score	C/D (this study)				
	In-stream toxicity	Some toxicity from industry and waste water treatment works				
Toxics	Ammonia	B	<44µg/L	Yes to D	95 th percentile to be<44µg/L	Monthly

See Ecospecs for fish and invertebrates respectively

Assess only if the biomonitoring results indicate there is a serious problem and the cause is unknown. An impact is expected if the 95th percentile of the data exceeds the Chronic Effects Value (CEV) as stated in DWAF (1996).

MAR EWR1: A31A-Kaaloo se Loop, below the gorge, before confluence with Marico River

Table 5.17: PES categories and overall site assessment for Mar EWR site 1

River	Kaaloo se Loop	Water Quality Monitoring points	PES Value	Category/Comment
WQSU	1	AZH036 Steenbokfontein on Koster River 2003-2007 (n=97)		
EWR Site	MAR EWR 1	188041 Rietspruit at Bridge on Kaaloo se Loop 2004-2008 (n=9)		
Water Quality Constituents				
Inorganic salts(mg/L)	MgSO ₄	14.765		Insufficient data to run TEACHA effectively. EC can be used as an indication of inorganic salts for PAI
	Na ₂ SO ₄	0		
	MgCl ₂	3.015		
	CaCl ₂	4.978		
	NaCl	8.717		
Nutrients(mg/L)	PO ₄	0.016	0.02	B (1)
	TIN	0.090	0.13	A (0)
Physical variables	pH (5 th -95 th %)	7.32-7.98	8.15-8.45	B (1)
	Temperature (°C)		9.95-19.44	A/B (0.5)
	Dissolved oxygen (mg/L)		4.65-13.32	A/B (0.5)
	Electrical Conductivity (mS/m)	16.58	31.06	B (1)
Response variable	Chl-a: periphyton (mg/m ²)			
	Macro-invertebrates		5.8	A/B
	Fish community score		86.3	B
Toxics	In-stream toxicity			
	Ammonia (µg/L)	0.003	0.14	A(0)
Overall site ecological category	Fluoride (µg/L)	0.20	0.02	B(1)
				A/B

Table 5.18: Water quality specifications for the Reserve (Quality Ecospecs) at MAR EWR 1Kaaloog se Loop River

RIVER	WATER QUALITY MONITORING POINTS					
	Kaaloog se Loop River	188041 Rietspruit at bridge on Kaaloog se Loop 2004-2008 (n=9)				
WQSU	1	DWA/WQWMS				
EWR SITE	EWR1	RHP				
Confidence in PES assessment						
	Low	Currently several monitoring sites				
Water Quality constituents	PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency	
Inorganic salts (mg/L)	MgSO ₄	Insufficient data to run TEACHA effectively. EC can be used as an indication of inorganic salts for PAI	≤23mg/L		95 th percentile to be <23mg/L	
	Na ₂ SO ₄		≤33mg/L		95 th percentile to be <33mg/L	
	MgCl ₂		≤30mg/L	N/A	95 th percentile to be <30mg/L	Monthly
	CaCl ₂		≤57mg/L		95 th percentile to be <57mg/L	
Nutrients (mg/L)	NaCl		≤191mg/L		95 th percentile to be <191mg/L	
	SRP	Category=B	<0.015mg/L	No	50 th percentile to be <0.015mg/L	Monthly
	TIN	Category=A	<0.75mg/L	No	50 th percentile to be <0.75mg/L	Monthly
	pH	Neutral river	>6.5 and <8.8	No	95 th percentile to be <8.8 and >6.5	Monthly
Physical Variables	Temperature	Limited data and is not impacted upstream		N/A	Maintain natural range	Monthly
	Dissolved oxygen			N/A	5 th percentile to be >7mg/L.	Monthly
	Turbidity (NTU)	Turbid after heavy rains due to upstream slate mining	Moderate change allowed	N/A	Moderate change allowed	Monthly
	Electrical conductivity (mS/m)	Category=B	≤55mS/m	No	95 th percentile to be <55mS/m	Quarterly
Response variables	Chla: periphyton	Visual inspection indicates limited algal concentrations on rocks and in pools	≤1.7mg/m (A category)	N/A	50 th percentile to be <1.7mg/m ²	Quarterly
	Chla: phytoplankton		≤10µg/L (A category)		50 th percentile to be <10µg/L	
	Macro-invertebrates (ASPT)	A/B (this study and RHP)				
Toxics	Fish community score	B (this study)				
	In-stream toxicity	No toxicity				
Toxics	Ammonia	A	≤15µg/L		95 th percentile to be <15µg/L	Monthly

See Ecospecs for fish and invertebrates respectively

Assess only if the biomonitoring results indicate there is a serious problem and the cause is unknown.

MAR EWR2: A31B-Groot Marico River Upstream confluence of the Sterkstroom

Table 5.19: PES categories and overall site assessment for Mar EWR site 2

River	Groot Marico	Water Quality Monitoring points	Category/Comment
WGSU	1	RC A2H036 Steenbokfontein on Koster River 2003-2007 (n=97)	
EWR Site	MAR EWR 2	PES 188035 Koedoesfontein on Groot-Marico River 2004-2008 (n=9)	
Water Quality Constituents		RC Value	PES Value
Inorganic salts (mg/L)		14.765	
	MgSO ₄	0	
	Na ₂ SO ₄	3.015	
	MgCl ₂	4.978	
	CaCl ₂	8.717	
	NaCl	0.016	0.02
	PO ₄	0.090	0.11
	TIN	7.32-7.98	8.02-8.38
Physical variables			
	pH (5 th -95 th %)		11.95-22.65
	Temperature (°C)		2.09-8.83
	Dissolved oxygen (mg/L)	16.58	34.1
	Electrical Conductivity (mS/m)		
	Chl-a: periphyton (mg/m ²)		
Response variable			
	Macro-invertebrates		A/B
	Fish community score		B
	In-stream toxicity		
Toxics	Fluoride (µg/L)	0.20	0.02
Overall site ecological category			B

MAR EWR3: A31F-Groot Marico River downstream of Marico Bosveld Dam

Table 5.21: PES categories and overall site assessment for Mar EWR site 3

River	Groot Marico	Water Quality Monitoring points	PES Value	Category/Comment
WQSU	3	RC A2H036 Steenbokfontein on Koster River 2003-2007 (n=97)		
EWR Site	MAR EWR 3	PES A3H028 Riekersdam on left canal from Marico-Bosveld Dam 2002-2007 (n=141)		
Water Quality Constituents				
Inorganic salts (mg/L)	MgSO ₄	RC Value	17.112	B(1)
	Na ₂ SO ₄		0	A(0)
	MgCl ₂		3.7	A(0)
	CaCl ₂		4.226	A(0)
Nutrients (mg/L)	NaCl		5.603	A(0)
	PO ₄		0.023	C(2)
	TIN		0.090	B(1)
Physical variables	pH (5 th -95 th %)		7.32-7.98	B(1)
	Temperature (°C)		12.7-24.3	B(1)
	Dissolved oxygen (mg/L)		2.29-8.33	B(1)
	Electrical Conductivity (mS/m)		16.58	B(1)
Response variable	Chl-a: periphyton (mg/m ²)		37.3	B(1)
	Macro-invertebrates		5.3	C(2)
	Fish community score		35	D(3)
Toxics	In-stream toxicity			
	Ammonia (µg/L)		0.003	B(1)
	Fluoride (µg/L)		0.20	A(0)
Overall site ecological category				B/C

Table 5.22: Water quality specifications for the Reserve (Quality Ecospecs) at MAR EWR 3

RIVER		Marico	WATER QUALITY MONITORING POINTS				
WQSU	3	DWA/WQMS	A3H028 Riekersdam on left canal from Marico-Bosveld Dam 2002-2007 (n=141)				
EWR SITE	MAR EWR3	RHP	Currently several monitoring sites				
Confidence in PES assessment		Medium					
Water Quality constituents		PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency	
Inorganic salts (mg/L)	MgSO ₄	A/B	≤23mg/L		95 th percentile to be <23mg/L		
	Na ₂ SO ₄		≤20mg/L		95 th percentile to be <20mg/L		
	MgCl ₂		≤15mg/L	N/A	95 th percentile to be <15mg/L	Monthly	
	CaCl ₂		≤21mg/L		95 th percentile to be <21mg/L		
Nutrients (mg/L)	NaCl		≤45mg/L		95 th percentile to be <45mg/L		
	SRP	Category= C	<0.015mg/L	Yes to D	50 th percentile to be <0.025mg/L	Monthly	
	TIN	Category=B	<0.75mg/L	Yes to D	50 th percentile to be <0.7mg/L	Monthly	
Physical Variables	pH	Good	>6.5 and <8.8	No	95 th percentile to be <8.8 and >6.5	Monthly	
	Temperature	Limited data and is impacted by Marico Bosveld Dam	Maintain range	N/A	Maintain natural range	Monthly	
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be >7mg/L	Monthly	
	Turbidity (NTU)	Turbid after heavy rains due to upstream slate mining	Moderate change allowed		N/A	Moderate change allowed	Monthly
	Electrical conductivity (mS/m)	Category= B	≤55mS/m		No	95 th percentile to be <85mS/m	Quarterly
Response variables	Chla: periphyton	Category=C. Visual inspection indicates high algal concentrations on rocks and in pools due to upstream agricultural runoff	≤84mg/m ² (D category)	N/A	50 th percentile to be <84mg/m ²	Quarterly	
	Chla: phytoplankton		≤30µg/L (D category)		50 th percentile to be <30µg/L		
	Macro-invertebrates (ASPT)	C (this study)			See Ecospecs for fish and invertebrates respectively		
Toxics	Fish community score	D (this study)					
	In-stream toxicity	Some toxicity from agricultural runoff upstream			Assess only if the biomonitoring results indicate there is a serious problem and the cause is unknown.		
	Ammonia	B	≤43.7ug/L	Yes to D	95 th percentile to be <43.7ug/L	Monthly	

MAR EWR4: A32D-Groot Marico River downstream Tswasa weir, in the Madikwe Game Reserve

Table 5.23: PES categories and overall site assessment for Mar EWR site 4

River	Groot Marico	Water Quality Monitoring points			Category/Comment
		RC	PES	PES Value	
WGSU	9	A2H036 Steenbokfontein on Koster River 2003-2007	(n=97)		D(3)
EWR Site	MAR EWR 4	A3H040 Marico River at Moolplaats/Tswasa weir	2002-2007	(n=181)	
Water Quality Constituents					
Inorganic salts (mg/L)	MgSO ₄	14.765	32.787		D(3)
	Na ₂ SO ₄	0	0		A(0)
	MgCl ₂	3.015	5.949		A(0)
	CaCl ₂	4.978	5.903		A(0)
	NaCl	8.717	8.698		A(0)
Nutrients (mg/L)	PO ₄	0.016	0.018		B/C(1.5)
	TIN	0.090	0.08		B(1)
Physical variables	pH (5 th -95 th %)	7.32-7.98	8.025-8.524		B(1)
	Temperature (°C)		14.5-26.5		B(1)
	Dissolved oxygen (mg/L)		5.5-11.4		B(1)
	Electrical Conductivity (mS/m)	16.58	54.2		B(1)
Response variable	Chl-a: periphyton (mg/m ²)				
	Macro-invertebrates		4.5		C
	Fish community score		61.8		C/D
Toxics	In-stream toxicity				
	Ammonia (µg/L)	0.003	0.003		A(0)
	Fluoride (µg/L)	0.20	0.6		A(0)
Overall site ecological category					B

Table 5.24: Water quality specifications for the Reserve (Quality Ecospecs) at MAR EWR 4

RIVER	Marico		WATER QUALITY MONITORING POINTS			
	9		DWAWQWMS	A3H040 Marico River at Mooiplaats/Tzwasa weir 2002-2007 (n=181)		
EWR SITE	MAR EWR4		RHP	Currently several monitoring sites		
Confidence in PES assessment						
Medium						
Water Quality constituents						
Inorganic salts (mg/L)	MgSO ₄	PES Category	WQ Ecospecs	Improvement required?	TPC	Monitoring frequency
	Na ₂ SO ₄		≤15mg/L		95 th percentile to be <15mg/L	
	MgCl ₂		≤20mg/L	N/A	95 th percentile to be <20mg/L	Monthly
	CaCl ₂		≤21mg/L		95 th percentile to be <21mg/L	
	NaCl		≤45mg/L		95 th percentile to be <45mg/L	
Nutrients (mg/L)	SRP	Category=B/C	≤0.125mg/L	Yes to D	50 th percentile to be <0.125mg/L	Monthly
	TIN	Category=A	≤0.25mg/L	Yes to D	50 th percentile to be <0.25mg/L	Monthly
	pH	Category=B, Good	>5.9 and <8.8	No	95 th percentile to be <8.8 and >5.9	Monthly
Physical Variables	Temperature	Limited data and is impacted by upstream impoundments	Maintain range	N/A	Maintain natural range	Monthly
	Dissolved oxygen		7-8mg/L	N/A	5 th percentile to be >7mg/L	Monthly
	Turbidity (NTU)	Turbid after heavy rains	Moderate change allowed	N/A	Moderate change allowed	Monthly
	Electrical conductivity (mS/m)	Category= B	≤55mS/m	No	95 th percentile to be <55mS/m	Quarterly
Response variables	Chla: periphyton	Visual inspection indicates low algal concentrations on rocks and in pools	≤12mg/m ² (B category)	N/A	50 th percentile to be <12mg/m ²	Quarterly
	Chla: phytoplankton		≤15µg/L (B category)		50 th percentile to be <15µg/L	
	Macro-invertebrates (ASPT)	C (this study)				
Toxics	Fish community score	C/D (this study)			See Ecospecs for fish and invertebrates respectively	
	In-stream toxicity	Limited toxicity from upstream urbanisation, waste water treatment works and agricultural runoff			Assess only if the biomonitoring results indicate there is a serious problem and the cause is unknown.	
	Ammonia	A	≤15µg/L		95 th percentile to be <15µg/L	Monthly

6. GROUNDWATER - QUANTITY COMPONENT

Table 6.1: Groundwater Resource Directed Measures (GRDM) Template

Quaternary Catchment	Area(km ²)	Recharge (Mm ³ /a)	Population (Water Services) 2011)	Baseflow (Mm ³ /a)	MLF_EWR (Mm ³ /a)	BHN Reserve (Mm ³ /a)	Reserve (Mm ³ /a)	Reserve as % of Recharge	Current Groundwater Use (Mm ³ /a)	Stress Index
A10A	559	8.81	49366	0.00	0.35	0.45	0.80	9.08	1.37	0.16
A10B	1015	12.56	25432	0.00	0.85	0.23	1.08	8.60	1.32	0.11
A10C	271	3.58	4099	0.00	0.19	0.04	0.23	6.42	0.85	0.24
A21A	483	27.641	151332	0.54	2.51	1.38	3.89	14.08	20.35	0.74
A21B	527	30.215	758882	0.32	1.60	6.92	8.52	28.21	11.58	0.38
A21C	761	18.684	545170	1.04	5.90	4.97	10.87	58.20	1.17	0.06
A21D	372	19.655	210207	1.51	4.20	1.92	6.12	31.13	11.53	0.59
A21E	290	9.207	15659	0.41	2.49	0.14	2.63	28.60	0.77	0.08
A21F	1,000	47.399	9362	1.26	3.10	0.09	3.19	6.72	33.62	0.71
A21G	161	6.238	110652	1.74	5.23	1.01	6.24	100.03	0.49	0.08
A21H	514	20.892	45327	2.56	3.67	0.41	4.08	19.55	3.23	0.15
A21J	1,150	29.893	133204	0.29	2.02	1.22	3.24	10.82	14.10	0.47
A21K	864	23.279	88100	1.51	2.87	0.80	3.67	15.78	13.54	0.58
A21L	213	4.497	43	0.16	0.19	0.00	0.19	4.23	0.61	0.14
A22A	706	21.318	40641	0.35	1.20	0.37	1.57	7.37	1.87	0.09
A22B	284	9.365	40288	0.19	0.66	0.37	1.03	10.97	1.80	0.19
A22C	515	17.303	40288	0.00	1.30	0.37	1.67	9.64	1.03	0.06
A22D	541	14.177	40288	0.10	0.60	0.37	0.97	6.83	4.02	0.28
A22E	812	19.386	6427	0.16	1.41	0.06	1.47	7.58	1.90	0.10
A22F	1,688	35.691	130476	0.95	2.25	1.19	3.44	9.64	4.02	0.11
A22G	499	17.989	846	0.35	1.00	0.01	1.01	5.60	1.46	0.08
A22H	579	15.612	230416	0.06	0.36	2.10	2.46	15.77	6.16	0.39
A22J	592	8.518	39935	0.22	0.81	0.36	1.17	13.79	2.20	0.26
A23A	682	28.30	391615	13.45	4.10	3.57	7.67	27.10	12.77	0.45
A23B	814	10.502	36522	0.28	2.00	0.33	2.33	22.22	1.45	0.14
A23C	491	6.2	2308	0.10	0.74	0.02	0.76	12.28	0.79	0.13
A23D	252	18.726	125166	1.77	2.43	1.14	3.57	19.08	13.73	0.73
A23E	490	6.28	75096	0.06	1.51	0.69	2.20	34.96	3.10	0.49
A23F	565	6.476	361907	0.28	0.69	3.30	3.99	61.65	0.74	0.11
A23G	951	20.58	75670	0.82	0.82	0.69	1.51	7.34	10.89	0.53
A23H	1,058	28.124	14570	0.13	2.20	0.13	2.33	8.30	2.59	0.09
A23J	930	6.782	647955	0.82	1.56	5.91	7.47	110.18	0.43	0.06
A23K	1,131	10.964	452332	0.13	1.20	4.13	5.33	48.59	0.50	0.05
A23L	329	3.074	4423	0.35	0.60	0.04	0.64	20.83	0.62	0.20

Quaternary Catchment	Area (km ²)	Recharge (Mm ³ /a)	Population (Water Services) 2011)	Baseflow (Mm ³ /a)	MLF_EWR (Mm ³ /a)	BHN Reserve (Mm ³ /a)	Reserve (Mm ³ /a)	Reserve as % of Recharge	Current Groundwater Use (Mm ³ /a)	Stress Index
A24A	493	5.73	8153	0.92	0.95	0.07	1.02	17.88	2.91	0.51
A24B	709	18.594	732	0.22	1.10	0.01	1.11	5.95	1.05	0.06
A24C	801	20.297	25539	0.13	0.07	0.23	0.30	1.49	11.18	0.55
A24D	1,327	20.547	50853	0.00	1.43	0.46	1.89	9.22	1.46	0.07
A24E	688	10.585	42926	0.00	0.73	0.39	1.12	10.60	0.01	0.00
A24F	591	12.09	25539	0.00	0.68	0.23	0.91	7.55	6.04	0.50
A24G	735	24.662	25539	0.35	2.12	0.23	2.35	9.54	0.36	0.01
A24H	1,338	37.309	56281	1.86	1.35	0.51	1.86	4.99	4.21	0.11
A24J	2,516	35.192	3778	0.60	1.71	0.03	1.74	4.96	39.50	1.12
A31A	632	16.878	9106	6.00	1.83	0.08	1.91	11.33	3.64	0.22
A31B	596	15.928	1390	6.00	3.02	0.01	3.03	19.04	2.68	0.17
A31C	485	15.045	2597	1.00	0.32	0.02	0.34	2.28	3.77	0.25
A31D	704	20.906	15615	1.00	0.55	0.14	0.69	3.31	3.42	0.16
A31E	601	17.336	936	2.00	1.25	0.01	1.26	7.26	0.81	0.09
A31F	702	22.388	24060	2.00	0.90	0.22	1.12	5.00	2.13	0.10
A31G	1,425	24.094	46990	4.00	3.17	0.43	3.60	14.94	0.67	0.03
A31H	684	15.299	32553	0.00	0.64	0.30	0.94	6.12	0.45	0.03
A31J	844	18.52	536	0.00	0.31	0.00	0.31	1.70	0.27	0.01
A32A	472	5.425	9952	0.00	0.18	0.09	0.27	4.99	0.04	0.01
A32B	641	14.587	5439	0.00	0.47	0.05	0.52	3.56	0.05	0.00
A32C	902	17.582	77	0.00	0.59	0.00	0.59	3.36	0.00	0.00
A32D	843	14.373	1538	0.00	0.59	0.01	0.60	4.20	0.13	0.01
A32E	2,499	15.775	2776	0.00	1.66	0.03	1.69	10.68	0.60	0.04

7. GROUNDWATER - QUALITY COMPONENT

Groundwater quality per quaternary catchment was determined from the data sets obtained from the Water Management System of the Department of Water and Sanitation. Groundwater quality was defined by the water quality specifications in Table 7.1 below.

Table 7.1: Water Quality Specifications

Chemical Parameter	Target Water Quality Ranges ¹			
	Class 0	Class I	Class II	Class III
pH	6 – 9	5 – 6 & 9 – 9.5	4 – 5 & 9.5 – 10	<4 & > 10
Electrical Conductivity	< 70	70 - 150	150 – 370	> 370
Calcium as Ca	< 80	80 - 150	150 – 300	> 300
Magnesium as Mg	< 70	70 - 100	100 – 200	> 200
Sodium as Na	< 100	100 - 200	200 – 400	> 400
Chloride as Cl	< 100	100 - 200	200 – 600	> 600
Sulphate as SO ₄	< 200	200 - 400	400 – 600	> 600
Nitrate as NO _x -N	< 6	6 - 10	10 – 20	> 20
Fluoride as F	<0.7	0.7 – 1.0	1.0 – 1.5	> 1.5

¹ Ref: *Quality of Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed.*1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa.

NOTE:

- Class 0** This is ideal water quality, suitable for lifetime use, with no adverse health effects on the user. This class is essentially the same as the target water quality range in the 2nd edition of the *South African Water Quality Guidelines for Domestic Use* (DWAF, 1996).
- Class I** Water in this class is safe for lifetime use, but falls short of the ideal water quality in that there may be instances of adverse health effects, but these are usually mild, and overt health effects are almost sub-clinical and difficult to demonstrate. Water in Class I does not cause health effects under normal circumstances. Aesthetic effects may, however, be apparent.
- Class II** Water in this class is defined as that where adverse health effects are unusual for limited short-term use. Adverse health effects may become more common particularly with prolonged use over many years, or with lifetime use. This class represents water suitable for short-term or emergency use only, but not necessarily suitable for continuous use over a lifetime.
- Class III** This water has constituents in a concentration range where serious health effects might be anticipated, particularly in infants or elderly people with short-term use, and even more so with longer term use. The water in this class is not suitable for use as drinking water without adequate treatment to shift the water into a lower and safer class.

Table 7.2: Groundwater quality per Quaternary Catchment

Chemical Parameter	Unit	Quaternary Catchments A21A, A21B, A21C & A21D												
		No. of Samples			Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³				
		A21A	A21B	A21C	A21D	A21A	A21B	A21C		A21D	A21A	A21B	A21C	A21D
pH		377	227	1510	635	7.75	7.60	6.54	7.23	5.0 – 9.5	6.98 – 8.53	6.84 – 8.36	5.89 – 7.19	6.51 – 7.95
Electrical Conductivity	mS/m	383	227	1501	638	25.80	51.00	198.00	66.00	<150	28.38	56.10	198.00	72.60
Calcium as Ca	mg/l	344	227	1294	635	25.40	47.00	198.40	59.00	<150	27.94	51.70	198.40	64.90
Magnesium as Mg	mg/l	344	227	1295	635	15.10	31.00	94.90	28.00	<100	16.61	34.10	100.00	30.80
Sodium as Na	mg/l	344	227	1294	638	3.00	10.00	87.30	25.00	<200	3.30	11.00	96.03	27.50
Chloride as Cl	mg/l	344	227	1331	638	3.60	12.00	70.00	14.00	<200	3.96	13.20	77.00	15.40
Sulphate as SO ₄	mg/l	344	227	1452	629	4.50	13.00	460.00	154.00	<400	4.95	14.30	460.00	169.40
Nitrate as NO ₃ -N	mg/l	343	227	1316	578	0.80	2.30	71.90	2.30	<10	0.88	2.53	71.90	2.53
Fluoride as F	mg/l	344	227	520	578	0.12	0.14	0.70	0.05	<1.0	0.13	0.15	0.77	0.06
Chemical Parameter	Unit	Quaternary Catchments A21E, A21F, A21G & A21H												
		No. of Samples			Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³				
		A21E	A21F	A21G	A21H	A21E	A21F	A21G		A21H	A21E	A21F	A21G	A21H
pH		3	307	118	7	6.70	7.58	8.24	7.90	5.0 – 9.5	6.03 – 7.37	6.82 – 8.34	7.42 – 9.06	7.11 – 8.69
Electrical Conductivity	mS/m	3	324	126	7	20.10	25.60	37.00	47.10	<150	22.11	28.16	40.70	51.81
Calcium as Ca	mg/l	3	311	116	4	10.83	25.40	39.80	27.72	<150	11.92	27.94	43.78	30.49
Magnesium as Mg	mg/l	3	311	116	4	4.30	15.80	24.00	22.10	<100	4.73	17.38	26.40	24.30
Sodium as Na	mg/l	3	311	116	4	18.10	2.50	1.00	28.76	<200	19.91	2.75	1.10	31.63
Chloride as Cl	mg/l	3	311	116	4	19.73	1.50	3.70	12.89	<200	21.71	1.65	4.07	14.17
Sulphate as SO ₄	mg/l	3	311	116	4	4.47	4.80	5.05	12.23	<400	4.91	5.28	5.56	13.45
Nitrate as NO ₃ -N	mg/l	3	312	118	4	2.57	0.26	0.17	0.45	<10	2.82	0.29	0.19	0.49
Fluoride as F	mg/l	–	311	116	4	–	0.10	0.12	0.29	<1.0	–	0.11	0.13	0.32

Chemical Parameter	Unit	Quaternary Catchments A21J, A21K, A21L & A22A													
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³				
		A21J	A21K	A21L	A22A	A21J	A21K	A21L	A22A		A21J	A21K	A21L	A22A	
pH		150	1795	10	40	6.90	7.67	7.61	7.50	5.0 – 9.5	6.21 – 7.59	6.90 – 8.43	6.85 – 8.37	6.75 – 8.25	
Electrical Conductivity	mS/m	150	1794	10	40	179.50	330.50	31.80	32.35	<150	179.50	330.50	34.98	35.38	
Calcium as Ca	mg/l	142	1801	9	36	72.36	234.00	32.00	5.72	<150	79.60	234.00	35.20	6.29	
Magnesium as Mg	mg/l	142	1801	9	36	97.98	158.00	6.10	22.43	<100	100.00	158.00	6.71	24.67	
Sodium as Na	mg/l	141	1800	9	36	125.30	256.96	23.46	17.56	<200	136.83	256.96	25.80	19.32	
Chloride as Cl	mg/l	142	1796	9	36	199.06	370.59	5.00	5.00	<200	200.00	370.59	5.50	5.50	
Sulphate as SO ₄	mg/l	141	1796	9	36	192.65	836.09	5.20	5.79	<400	211.92	836.09	5.72	6.37	
Nitrate as NO _x -N	mg/l	142	1770	9	36	7.29	3.05	3.75	0.31	<10	8.02	3.35	4.12	0.33	
Fluoride as F	mg/l	142	1560	9	36	0.22	0.01	0.33	0.32	<1.0	0.24	0.011	0.37	0.35	
Chemical Parameter	Unit	Quaternary Catchments A22B, A22C, A22D & A22E													
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³				
		A22B ¹	A22C ¹	A22D ¹	A22E	A22B ¹	A22C ¹	A22D ¹	A22E		A22B ¹	A22C ¹	A22D ¹	A22E	
pH		29	108	4	29	7.96	7.80	7.23	7.96	5.0 – 9.5	7.16 – 8.75	7.02 – 8.58	6.51 – 7.96	7.16 – 8.75	
Electrical Conductivity	mS/m	29	108	4	29	38.80	42.95	38.95	38.80	<150	42.68	47.25	42.84	42.68	
Calcium as Ca	mg/l	29	101	4	29	27.40	45.50	17.20	27.40	<150	30.14	50.05	18.92	30.14	
Magnesium as Mg	mg/l	29	101	4	29	25.83	26.90	23.62	25.83	<100	28.42	29.59	25.99	28.42	
Sodium as Na	mg/l	29	101	4	29	6.80	4.44	13.58	6.80	<200	7.48	4.88	14.94	7.48	
Chloride as Cl	mg/l	29	101	4	29	5.00	4.10	5.25	5.00	<200	5.50	4.51	5.78	5.50	
Sulphate as SO ₄	mg/l	29	101	4	29	6.18	5.00	3.70	6.18	<400	6.80	5.50	4.07	6.80	
Nitrate as NO _x -N	mg/l	29	101	4	29	0.56	1.04	2.01	0.56	<10	0.61	1.15	2.21	0.61	
Fluoride as F	mg/l	29	101	4	29	0.35	0.12	0.35	0.35	<1.0	0.38	0.13	0.39	0.38	

Chemical Parameter	Unit	Quaternary Catchments A22F, A22G, A22H & A22J															
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²		Groundwater Quality Reserve ³					
		A22F	A22G	A22H	A22J	A22F	A22G	A22H	A22J	A22F	A22G	A22H	A22J	A22F	A22G	A22H	A22J
pH		52	108	3457	25	7.88	7.80	7.64	7.94	5.0 – 9.5	7.02–8.67	6.88–8.40	7.15–8.73				
Electrical Conductivity	mS/m	52	108	3457	25	58.05	42.95	412.00	108.00	<150	63.86	47.25	412.00	118.80			
Calcium as Ca	mg/l	46	101	3460	20	43.75	45.50	288.84	100.68	<150	48.13	50.05	288.84	110.75			
Magnesium as Mg	mg/l	46	101	3461	20	20.74	26.90	205.50	62.56	<100	22.81	29.59	205.50	68.82			
Sodium as Na	mg/l	46	101	3461	20	28.27	4.44	313.50	48.37	<200	31.10	4.88	313.50	53.20			
Chloride as Cl	mg/l	46	101	3456	20	18.63	4.10	325.94	43.32	<200	20.49	4.51	325.94	47.65			
Sulphate as SO ₄	mg/l	46	101	3457	20	25.99	5.00	1169.29	46.64	<400	28.59	5.50	1169.29	51.30			
Nitrate as NO ₃ -N	mg/l	46	101	3405	20	0.24	1.04	15.95	15.95	<10	0.26	1.15	15.95				
Fluoride as F	mg/l	46	101	2967	20	0.48	0.12	0.01	0.15	<1.0	0.53	0.13	0.011	0.16			
Chemical Parameter	Unit	Quaternary Catchments A23A, A23B, A23C & A23D															
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²		Groundwater Quality Reserve ³					
		A23A	A23B	A23C	A23D	A23A	A23B	A23C	A23D	A23A	A23B	A23C	A23D	A23A	A23B	A23C	A23D
pH		148	798	83	31	7.20	7.90	7.92	7.70	5.0 – 9.5	6.48–7.92	7.13–8.71	6.93–8.47				
Electrical Conductivity	mS/m	148	817	83	31	47.00	53.00	250.00	37.20	<150	51.70	58.30	250.00	40.92			
Calcium as Ca	mg/l	149	757	76	31	40.00	54.00	84.06	32.20	<150	44.00	59.40	92.47	35.42			
Magnesium as Mg	mg/l	149	758	76	31	23.00	33.00	53.15	24.00	<100	25.30	36.30	58.47	26.40			
Sodium as Na	mg/l	149	758	74	31	16.00	4.00	371.04	4.90	<200	17.60	4.40	371.04	5.39			
Chloride as Cl	mg/l	149	758	76	31	7.00	6.00	413.64	5.30	<200	7.70	6.60	413.64	5.83			
Sulphate as SO ₄	mg/l	149	758	74	31	5.00	5.00	109.77	11.50	<400	5.50	5.50	120.74	12.65			
Nitrate as NO ₃ -N	mg/l	149	797	76	31	3.00	1.00	11.45	0.83	<10	3.30	1.10	11.45	0.91			
Fluoride as F	mg/l	149	758	76	31	0.20	0.15	1.01	0.11	<1.0	0.22	0.17	1.01	0.12			

Chemical Parameter	Unit	Quaternary Catchments A23E, A23F, A23G, A23H															
		No. of Samples						Ambient GW quality or median ¹				BHN Reserve ²		Groundwater Quality Reserve ³			
		A23E	A23F	A23G	A23H	A23E	A23F	A23G	A23H	A23E	A23F	A23G	A23H	A23E	A23F	A23G	A23H
pH		988	6	266	68	7.66	7.32	7.93	8.47	5.0 – 9.5	6.89–8.43	6.59–8.05	7.14–8.72	7.62–8.47			
Electrical Conductivity	mS/m	988	6	255	68	90.80	69.55	65.30	56.70	<150	99.88	76.51	71.83	62.37			
Calcium as Ca	mg/l	988	6	255	67	82.60	41.40	24.10	53.90	<150	90.86	45.54	26.51	59.29			
Magnesium as Mg	mg/l	988	6	258	67	51.80	35.70	6.49	28.30	<100	56.98	39.27	7.14	31.13			
Sodium as Na	mg/l	988	6	266	67	31.46	24.65	60.90	18.60	<200	34.60	27.12	66.99	20.46			
Chloride as Cl	mg/l	988	6	255	67	71.25	42.60	53.55	10.10	<200	78.38	46.86	58.91	11.11			
Sulphate as SO ₄	mg/l	988	6	258	67	109.50	19.65	8.90	5.10	<400	120.45	21.62	9.79	5.61			
Nitrate as NO _x -N	mg/l	988	6	266	67	5.16	5.09	0.85	2.03	<10	5.67	5.60	0.94	2.23			
Fluoride as F	mg/l	988	6	258	67	0.05	0.36	0.69	0.30	<1.0	0.06	0.39	0.76	0.33			
Chemical Parameter	Unit	Quaternary Catchments A23J, A23K, A23L & A24A															
		No. of Samples						Ambient GW quality or median ¹				BHN Reserve ²		Groundwater Quality Reserve ³			
		A23J	A23K	A23L	A24A	A23J	A23K	A23L	A24A	A23J	A23K	A23L	A24A	A23J	A23K	A23L	A24A
pH		127	5	21	57	8.37	8.18	8.13	7.84	5.0 – 9.5	7.53–9.21	7.36–9.00	7.32–8.95	7.06–8.62			
Electrical Conductivity	mS/m	127	5	21	57	38.40	63.00	112.40	89.90	<150	42.24	69.30	123.64	98.89			
Calcium as Ca	mg/l	121	5	18	53	38.90	53.07	15.47	90.85	<150	42.79	58.38	17.02	99.94			
Magnesium as Mg	mg/l	122	5	18	53	23.75	16.20	2.30	52.14	<100	26.13	17.82	2.53	57.36			
Sodium as Na	mg/l	122	5	18	53	2.38	52.99	215.24	19.38	<200	2.62	58.29	215.24	21.32			
Chloride as Cl	mg/l	122	5	18	53	5.00	64.79	226.96	63.96	<200	5.50	71.26	226.96	70.36			
Sulphate as SO ₄	mg/l	121	5	18	53	6.70	11.90	10.43	10.60	<400	7.37	13.09	11.47	11.66			
Nitrate as NO _x -N	mg/l	123	5	18	53	0.17	0.77	0.04	1.24	<10	0.18	0.85	0.05	1.37			
Fluoride as F	mg/l	121	5	21	53	0.16	1.03	8.81	0.54	<1.0	0.18	1.03	8.81	0.59			

Chemical Parameter	Unit	Quaternary Catchments A24B, A24C, A24D & A24E												
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³			
		A24B	A24C	A24D	A24E	A24B	A24C	A24D	A24E		A24B	A24C	A24D	A24E
pH		36	137	24	10	7.70	7.70	8.19	7.92	5.0 – 9.5	6.93–8.47	6.93–8.47	6.93–8.47	7.13–8.71
Electrical Conductivity	mS/m	36	137	24	10	129.15	129.00	91.25	63.00	<150	141.90	141.90	119.60	69.30
Calcium as Ca	mg/l	36	139	20	8	115.50	79.50	1.96	64.10	<150	87.45	87.45	2.15	70.51
Magnesium as Mg	mg/l	36	139	20	8	85.50	58.00	129.85	34.65	<100	100.00	63.80	129.85	38.12
Sodium as Na	mg/l	36	139	20	8	77.40	90.50	5.91	26.50	<200	85.14	99.55	6.50	29.15
Chloride as Cl	mg/l	36	139	20	8	139.30	143.10	5.25	29.79	<200	153.23	157.41	5.78	32.77
Sulphate as SO ₄	mg/l	36	139	20	8	63.70	68.20	4.83	22.50	<400	70.07	75.02	5.32	24.75
Nitrate as NO ₃ -N	mg/l	36	139	20	8	8.63	3.75	1.98	14.95	<10	9.49	4.13	2.17	14.95
Fluoride as F	mg/l	36	139	20	8	0.81	0.84	0.10	0.25	<1.0	0.89	0.92	0.11	0.28

Chemical Parameter	Unit	Quaternary Catchments A24F, A24G, A24H & A24J												
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³			
		A24F	A24G	A24H	A24J	A24F	A24G	A24H	A24J		A24F	A24G	A24H	A24J
pH		444	8	26	309	7.60	7.00	7.59	7.90	5.0 – 9.5	6.84–8.36	6.30–7.70	6.83–8.35	7.11–8.69
Electrical Conductivity	mS/m	435	8	26	309	297.00	45.00	76.35	102.40	<150	297.00	49.50	83.99	112.64
Calcium as Ca	mg/l	434	8	26	278	152.00	41.00	44.75	62.80	<150	152.00	45.10	49.23	69.08
Magnesium as Mg	mg/l	433	8	26	278	115.00	4.00	32.30	58.10	<100	115.00	4.40	35.53	63.91
Sodium as Na	mg/l	446	8	26	278	305.00	33.00	38.60	62.80	<200	305.00	36.30	42.46	69.08
Chloride as Cl	mg/l	434	8	26	278	825.60	10.00	29.50	85.35	<200	825.60	11.00	32.45	93.89
Sulphate as SO ₄	mg/l	445	8	26	278	115.50	18.00	9.90	46.70	<400	127.05	19.80	10.89	51.37
Nitrate as NO ₃ -N	mg/l	336	8	26	278	3.48	0.12	0.89	5.56	<10	3.82	0.13	0.98	6.12
Fluoride as F	mg/l	392	8	26	278	0.21	3.00	0.67	0.68	<1.0	0.23	3.30	0.73	0.75

Chemical Parameter	Unit	Quaternary Catchments A31, A31B, A31C & A31D													
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³				
		A31A	A31B	A31C	A31D	A31A	A31B	A31C	A31D		A31A	A31B	A31C	A31D	
pH		75	30	480	710	8.05	7.37	7.90	8.00	5.0 – 9.5	7.25–8.86	6.63–8.11	7.11–8.69	7.20–8.80	
Electrical Conductivity	mS/m	75	30	526	758	30.50	69.75	47.40	50.90	<150	33.55	76.73	52.14	55.99	
Calcium as Ca	mg/l	75	25	473	695	30.54	85.27	47.60	53.50	<150	33.59	93.80	52.36	58.85	
Magnesium as Mg	mg/l	75	25	473	697	18.20	56.80	31.25	32.17	<100	20.02	62.48	34.38	35.39	
Sodium as Na	mg/l	75	25	473	697	3.40	17.60	2.60	3.20	<200	3.74	19.35	2.86	3.52	
Chloride as Cl	mg/l	75	25	473	698	5.69	35.90	4.60	5.69	<200	6.26	39.49	5.06	6.26	
Sulphate as SO ₄	mg/l	75	25	473	697	3.00	59.33	4.50	10.10	<400	3.30	65.26	4.95	11.11	
Nitrate as NO ₃ -N	mg/l	75	25	476	695	0.23	1.64	0.21	0.31	<10	0.25	1.81	0.23	0.35	
Fluoride as F	mg/l	75	25	473	682	0.10	0.26	0.19	0.23	<1.0	0.11	0.29	0.21	0.25	

Chemical Parameter	Unit	Quaternary Catchments A31E, A31F, A31G & A31H													
		No. of Samples				Ambient GW quality or median ¹				BHN Reserve ²	Groundwater Quality Reserve ³				
		A31E	A31F	A31G	A31H	A31E	A31F	A31G	A31H		A31E	A31F	A31G	A31H	
pH		7	26	16	27	7.50	7.79	8.13	7.92	5.0 – 9.5	6.75–8.25	7.01–8.57	7.32–8.95	7.13–8.71	
Electrical Conductivity	mS/m	7	26	16	27	17.70	74.65	41.95	76.40	<150	19.47	82.12	46.15	84.04	
Calcium as Ca	mg/l	7	21	13	22	14.20	18.10	20.93	44.68	<150	15.62	19.91	23.02	49.15	
Magnesium as Mg	mg/l	7	21	13	22	10.00	15.50	35.00	23.11	<100	11.00	17.05	38.50	25.42	
Sodium as Na	mg/l	7	21	13	22	5.80	14.70	8.55	81.63	<200	6.38	16.17	9.40	89.79	
Chloride as Cl	mg/l	7	22	13	22	3.30	5.30	5.00	65.68	<200	3.63	5.83	5.50	72.24	
Sulphate as SO ₄	mg/l	7	22	13	22	2.00	9.99	3.00	10.77	<400	2.20	10.99	3.30	11.85	
Nitrate as NO ₃ -N	mg/l	7	22	13	22	0.35	2.06	0.27	8.43	<10	0.38	2.27	0.30	9.27	
Fluoride as F	mg/l	7	22	13	22	0.27	0.16	0.11	0.42	<1.0	0.30	0.18	0.12	0.46	

Chemical Parameter	Unit	Quaternary Catchments A31J, A32A, A32B & A32C												
		No. of Samples			Ambient GW quality or median ¹			BHN Reserve ²	Groundwater Quality Reserve ³					
		A31J	A32A	A32B *	A32C *	A31J	A32A		A32B *	A32C *	A31J	A32A	A32B *	A32C *
pH		7	23	24	7	7.72	8.15	8.19	7.72	5.0 – 9.5	6.95–8.49	7.34–8.97	7.37–9.01	6.95–8.49
Electrical Conductivity	mS/m	7	23	24	7	76.00	90.10	91.25	76.00	<150	83.60	99.11	119.60	83.60
Calcium as Ca	mg/l	5	18	20	5	46.60	25.29	1.96	46.60	<150	51.26	27.82	2.15	51.26
Magnesium as Mg	mg/l	5	18	20	5	72.10	96.40	129.85	72.10	<100	79.31	106.04	129.85	79.31
Sodium as Na	mg/l	5	18	20	5	27.70	23.87	5.91	27.70	<200	30.47	26.25	6.50	30.47
Chloride as Cl	mg/l	6	18	20	6	4.70	25.39	5.25	4.70	<200	5.17	27.92	5.78	5.17
Sulphate as SO ₄	mg/l	5	18	20	5	22.40	33.30	4.83	22.40	<400	24.64	36.63	5.32	24.64
Nitrate as NO ₃ -N	mg/l	6	18	20	6	2.53	5.77	1.98	2.53	<10	2.78	6.35	2.17	2.78
Fluoride as F	mg/l	5	18	20	5	0.18	0.19	0.10	0.18	<1.0	0.20	0.21	0.11	0.20

Chemical Parameter	Unit	Quaternary Catchments A32D, A32E, A10A & A10B												
		No. of Samples			Ambient GW quality or median ¹			BHN Reserve ²	Groundwater Quality Reserve ³					
		A32D *	A32E	A10A	A10B	A32D *	A32E		A10A	A10B	A32D *	A32E	A10A	A10B
pH		24	68	503	38	8.19	8.06	7.98	7.88	5.0 – 9.5	7.37–9.01	7.25–8.87	7.18–8.78	7.09–8.67
Electrical Conductivity	mS/m	24	68	473	38	91.25	106.70	45.70	76.20	<150	119.60	117.34	50.27	83.82
Calcium as Ca	mg/l	20	63	435	31	1.96	64.97	49.10	45.20	<150	2.15	71.47	54.01	49.72
Magnesium as Mg	mg/l	20	63	499	31	129.85	67.79	29.00	26.40	<100	129.85	74.57	31.90	29.04
Sodium as Na	mg/l	20	63	499	31	5.91	66.66	2.40	56.41	<200	6.50	73.33	2.64	62.05
Chloride as Cl	mg/l	20	63	432	31	5.25	59.93	4.80	54.00	<200	5.78	65.48	5.28	59.40
Sulphate as SO ₄	mg/l	20	63	499	31	4.83	15.86	4.40	10.79	<400	5.32	17.45	4.84	11.87
Nitrate as NO ₃ -N	mg/l	20	67	500	32	1.98	11.81	0.79	7.34	<10	2.17	11.81	0.87	8.08
Fluoride as F	mg/l	20	63	499	31	0.10	0.41	0.10	0.40	<1.0	0.11	0.45	0.11	0.44

Chemical Parameter	Unit	Quaternary Catchment A10C			
		No. of Samples	Ambient GW quality or median ¹	BHN Reserve ²	Groundwater Quality Reserve ³
		A10C	A10C		A10C
pH		22	7.96	5.0 – 9.5	7.16–8.75
Electrical Conductivity	mS/m	22	108.60	<150	119.46
Calcium as Ca	mg/l	17	109.10	<150	120.01
Magnesium as Mg	mg/l	17	89.65	<100	98.62
Sodium as Na	mg/l	17	6.53	<200	7.18
Chloride as Cl	mg/l	17	18.91	<200	20.80
Sulphate as SO ₄	mg/l	17	9.12	<400	10.03
Nitrate as NO ₃ -N	mg/l	17	8.06	<10	8.86
Fluoride as F	mg/l	17	0.24	<1.0	0.26

¹⁾ Based on data obtained from the National Groundwater Archive. Values reported are the statistical median of each parameter.

²⁾ Ref. *Quality of Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed.* 1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa (Set for a Class 1).

³⁾ Where a difference in the water quality values for the ambient groundwater quality and basic human needs was found, the lesser or more protective value was selected for the groundwater quality Reserve. Where the ambient groundwater quality was selected as the groundwater quality Reserve, the value was scaled up by 10 per cent provided that the value does not exceed the BHN Reserve.

A total of 6 quaternary catchments do not have groundwater chemistry data, and are as highlighted in red in Table 7.2 above. The ambient groundwater quality was extrapolated from neighbouring quaternary catchments with a similar geology because geology has a huge bearing on the water quality of an area.

Table 7.3: Summary of the water quality class and parameters of concern

Quaternary catchment	Water quality class (WRC, 1998)	Water quality parameters of concern
A10A	0	None
A10B	I	None
A10C	I	Calcium, Electrical Conductivity, Magnesium, Nitrate
A21A	0	None
A21B	0	None
A21C	III	Calcium, Electrical Conductivity, Magnesium, Nitrate, Sulphate
A21D	0	None
A21E	0	None
A21F	0	None
A21G	0	None
A21H	0	None
A21J	I	Sodium, Magnesium, Chloride, Nitrate, Electrical Conductivity
A21K	III	Sulphate, Calcium, Magnesium, Sodium, Chloride, Electrical Conductivity
A21L	0	None
A22A	0	None
A22B	0	None
A22C	0	None
A22D	0	None
A22E	0	None
A22F	0	None
A22G	0	None
A22H	III	Sulphate, Electrical Conductivity, Calcium, Magnesium, Sodium, Chloride,
A22J	I	Electrical Conductivity, Nitrate
A23A	0	None
A23B	0	None
A23C	II	Chloride, Electrical Conductivity, Fluoride, Nitrate, Sodium
A23D	0	None
A23E	I	Calcium, Electrical Conductivity
A23F	0	None
A23G	0	None
A23H	0	None
A23J	0	None
A23K	II	Fluoride
A23L	III	Fluoride, Sodium, Chloride
A24A	I	Calcium, Electrical Conductivity
A24B	I	Electrical Conductivity, Calcium, Magnesium, Sodium, Chloride
A24C	I	Chloride, Fluoride, Electrical Conductivity
A24D	I	Magnesium, Electrical Conductivity
A24E	0	None
A24F	III	Chloride, Electrical Conductivity, Sodium, Magnesium, Calcium
A24G	0	None
A24H	I	Electrical Conductivity
A24J	I	Electrical Conductivity
A31A	0	None
A31B	I	Calcium
A31C	0	None
A31D	0	None
A31E	0	None
A31F	I	Electrical Conductivity
A31G	0	None
A31H	I	Electrical Conductivity, Nitrate
A31J	I	Magnesium, Electrical Conductivity
A32A	I	Magnesium, Electrical Conductivity
A32B	I	Magnesium, Electrical Conductivity
A32C	I	Magnesium, Electrical Conductivity
A32D	I	Magnesium, Electrical Conductivity
A32E	II	Nitrate

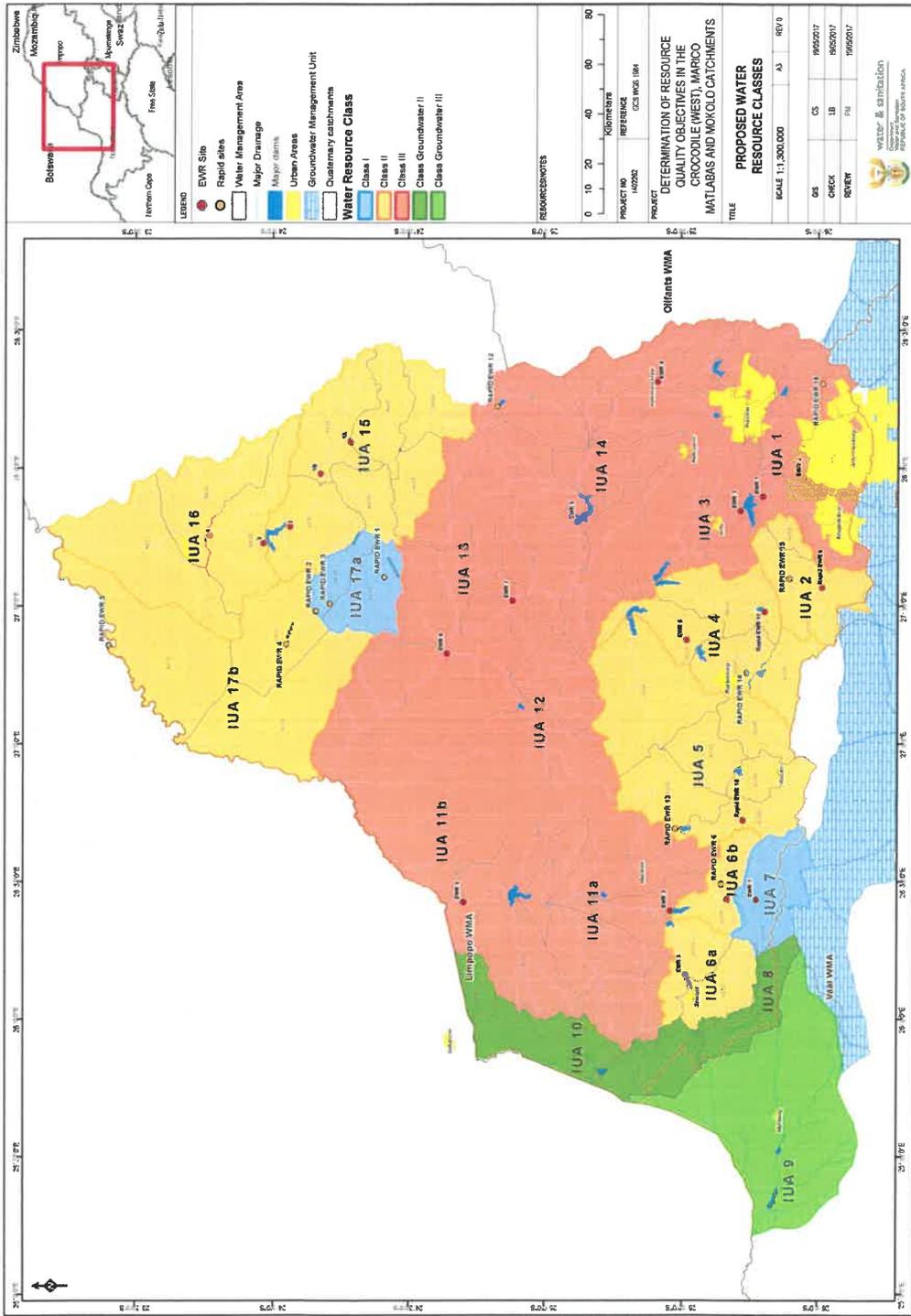


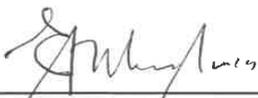
Figure 1: Locality map for the Crocodile (West), Marico catchments

KITSISO YA KAKARETSO

KITSISO YA No. _____ YA 2021**LEFAPHA LA METSI LE KGELELOLESWE****MOLAO WA BOSETŠHABA WA METSI WA 1998
(MOLAO WA NO. YA 36 WA 1998)****TLHOMAMISO YA RESEFE YA METSWEDI YA METSI YA MADUTELO A BOPHIRIMA JWA CROCODILE LE MARICO GO YA KA KAROLO YA 16(1) LE YA (2) YA MOLAO WA BOSETŠHABA WA METSI WA 1998 (MOLAO WA NO. YA 36 WA 1998)**

Nna Senzo Mchunu, mo maemong a me jaaka Tona ya Metsi le Kgeleloleswe, morago ga go obamela karolo ya 13 ya Molao wa Bosetšhaba wa Metsi wa 1998 (Molao wa No. ya 36 wa 1998) ("Molao"), le Molawana wa 3 wa Melawana ya Tlhagiso ya Thulaganyo ya Karoganyo ya Didirisiwa tsa Metsio (No. ya R. 810 No. ya Kitsiso ya 33541, ya 17 Lwetse 2010), e bile ke dumeletswe sentle go ya ka karolo ya 16(1) le ya 63(1)(a) ya Molao, morago ga go obamela karolo ya 16(2) le ya (3) ya Molao, ke phasalatsa Tlhomamiso ya Resefe ya metswedi ya metsi ya madutelo a Bophirima jwa Crocodile le Marico.

Mokaedi: Tlhomamiso ya Resefe
Go: Rre Yakeen Atwaru
Lefapha la Metsi le Kgeleloleswe
Kago ya Ndinaye
178 Mmila wa Francis Baard
Private Bag X313
Pretoria
0001
Imeile: atwaruy@dws.gov.za



SENZO MCHUNU (MP)
TONA YA METSI LE KGELELOLESWE
LETLHA: 13/10/2021

MAMETLELELO**TLHOMAMISO YA RESEFE YA METSWEDI YA METSI YA MADUTELO A BOPHIRIMA JWA CROCODILE LE MARICO GO YA KA KAROLO YA 16(1) LE YA (2) YA MOLAO WA BOSETŠHABA WA METSI WA 1998 (MOLAO WA NO.YA 36 WA 1998)****1. DIAKERONIMI LE DITLHALOSO****1.1. Lenane la Diakeronimi**

ASPT	Sekoro sa Palogare go ya ka Thekesene
BHN	Ditlhokwa tsa Motheo tsa Batho
CEV	Boleng jwa Ditlamorago tse di Tswelolang pele
DWA	Lefapha la Merero ya Metsi
DWAF	Lefapha la Metsi le Dikgwa
DWS	Lefapha la Metsi le Kgeleloleswe
EcoSpecs	Dikaelo tsa Ekholoji
EIS	Botlhokwa jwa Ekholoji le Bomasisi
EWR	Ditlhokego tsa Metsi tsa Ekholoji
FRAI	Indekese ya Tshekatsheko ya Tsibogo ya Ditlhapi
GRDM	Mokgwa wa Tlhomamiso ya Resefe ya Metsi a ka fa teng ga lefatshe
GW	Metsi a ka fa Teng ga lefatshe
HN	Sedirisiwa
MCM	Dikubikimitara di le Milione
MLF	Kelo ya Metsi ya Tlhokomelo
NMAR	Go gogiwa ga Metsi ka Ngwaga ka Mokgwa wa Tlhago
NTU	Diyuniti tsa Nefelometiriki tsa Tebiditi
PAI	Tshupane ya Tshekatsheko ya Setlhotlheletsi se se Bonagalang le sa Khemikale
PES	Maemo a Gajaana a Ekholoji
RC	Maemo a Tshupetso
REC	Karolo e e Atlanegisitsweng ya Ekholoji
RHP	Lenaane la Boitekanelo la Noka
SRP	Otofoseforase e e Tlhaologang e e Tsibogang
TIN	Naeterojene ya Botlalo e e sa Boleng
TPCs	Matseno a Ntla ya Kgonagalo
WMS	Thulaganyo ya Tsamaiso ya Metsi
WRC	Khomišene ya Patlisiso ya Metsi
WQ	Boleng jwa Metsi
WQSU	Diyunitipotlana tsa Boleng jwa Metsi

1.2. Ditlhaloso

Mo Mametlelelong e, lefoko lengwe le lengwe le le neetsweng bokao mo Molaong wa Bosetšhaba wa Metsi le tla kaya bokao jo le bo neetsweng gape, ntle le fa bokao bo kaya ka mokgwa mongwe-

“Kelelo ya kwa tlase” ke kelelo ya kwa tlase e e tswelediwang ya mo dinokeng ka nako ya maemo a bosa a a omileng le le a a siameng, fela a sa abelwa otlhe ke metsi a a kwa tlase ga lefatshe; go akaretsa kabelo go tswa mo kelelong ya ka fa gare e e diegileng le go tswa ga metsi a a ka fa tlase ga lefatshe;

“Setlhopha sa Motswedi wa Metsi” ke setlhopha sa dimelo tse di elediwang tsa tiriso le maemo a ekholoji a metswedi e e botlhokwa ya metsi mo bodutelong jo bo rileng (yuniti e e tshwaraganeng ya tshokatsheko). Setlhopha se tshwanetse go tlhalosa bogolo jwa tiriso ya metswedi ya metsi; Resefe; maitlhomo a boleng jwa motswedi le tlhomamiso ya karolo e e abiwang ya motswedi wa metsi o o dirisiwang. Motswedi wa metsi o tshwanetse go farologanngwa ka e le nngwe ya ditlhopha di le tharo, Setlhopha sa I motswedi wa metsi le Setlhopha sa II motswedi wa metsi le Setlhopha sa III motswedi wa metsi;

“Setlhopha sa Ekholoji” ke maemo a ekholoji go motswedi wa metsi a a kayang phapogo ya dikarolo tsa baeyofisikale ya motswedi wa mesti go tswa mo maemong a kaelo a tlhago;

“Botlhokwa le Bomasisi jwa Ekholoji” (EIS) bo kaya dibontshi tse di botlhokwa mo tlhophelong ya ekholoji ya metswedi ya metsi. Botlhokwa jwa Ekholoji bo amana le go nna teng, go emelwa le mefutafuta ya ditshedi tsa mo lefelong le le rileng le bonno. Bomasisi jwa ekholoji bo amana le ketsaetsego ya bonno le ditshedi mo lefelong le le rileng mo diphetogong tse di ka diragalang mo dikelelong, mo maemong a metsi le mo maemong a lefatshe a a nang le dikhemikale;

“Ditlhokego tsa Metsi tsa Ekholoji” (EWR) ke mekgwa ya kelelo (bogolo, nako le lobaka) le metsi a a boleng a a tlhokegang go tshola tikologo ya dinoka mo maemong a a rileng e bile lereo le le dirisiwa go kaya dikarolo tsa bokanakang le boleng ka bobedi tsa tikologo ya dinoka;

“Mafelo a Ditlhokego tsa Metsi tsa Ekholoji” (EWR) ke dintlha tse di totobetseng tsa noka jaaka go tlhomamisitswe ka thulaganyo ya tlhopho ya lefelo. Lefelo la EWR le na le bolelele jwa noka e e ka nnang le mefuta ya dikarolo tse di farologaneng ka maikemisetso a metsi le ekholoji. Mafelo a, a tlamela ka dibontshi tse di lekaneng go tlathlhaba dikelelo tsa tikologo le go tlathlhaba maemo a dikarolo tsa saense ya tiriso ya melao ya fisika mo bayolojing (ditlhotlheletsi tse di jaaka haeteroloji, jeomofoloji le dikhemikale tsa fisika) le ditsibogo tsa bayoloji (viz. ditlhapi, ditshedi tse di senang mokwatla le dimela tse di mo lotshitshing);

“Go tlatsa” ke koketso ya metsi mo lefelong le le kolobileng, ka nwelelo ya kwa tlase ya pula kgotsa metsi a a mo boalong le/ kgotsa go elela ga metsi a a ka fa tlase ga lefatshe a a gaufi le matlapa a a monang metsi;

“Karolo e e Atlanejisitsweng ya Ekholoji” (REC) ke karolo ya ekholoji e e bontshang taolo e e totilweng ya motswedi wa metsi e e ka ga tlhophelo ya ona ya ekholoji e e tshwanetseng go fitlhelwa. Dikarolo di tloga ka Karolo ya A (se se sa fetolwang, tlhago) go fitlha go Karolo ya D (se se fetotsweng thata);

“Resefe” ke bokanakang le boleng jwa metsi a a tlhokegang go kgotsofatsa ditlhokwa tsa motheo tsa batho ka go bona thebolelo ya motheo ya metsi le go sireletsa tikologo ya mo metsing kgotsa ya fa gaufi le metsi go bona tlhabololo e e tswelalang ya tikologo le tiriso ya motswedi o o maleba wa metsi;

“Mo noka e kopang le e nngwe teng” (kopano ya bayofisikale) ke dintlha tsa sekao tse di emetseng kelelo godimo kgotsa lefelo la metsi la thulaganyotikologo (dinoka, meraga, kgwelo le metsi a a ka fa tlase ga lefatshe) mo setlhopha sa dikamano se dirang teng.

2. TLHALOSO YA MOTSWEDI WA METSI

- 2.1 Resefe e tlhomamisiwago motswedi wa metsi otlhe o o botlhokwa kgotsa go karolo nngwe le nngwe e e botlhokwa ya ona mo madutelong a (Bophirima) jwa Crocodile le Marico, jaaka go tlhagisiwa fa tlase:

Lefelo la Tsamaiso ya Metsi: Limpopo
 Kgaolo ya Kgamolo: A21 go A24, A31 & A32 Kgaolo e Kgolwane ya Kgamolo
 Noka kgotsa dinoka: Dithulaganyo tsa noka ya (Bophirima) jwa Crocodile le ya Marico

- 2.2 Tona o go ya ka karolo ya 12 ya Molao wa Bosetšhaba wa Metsi wa 1998 (Molao wa No. ya 36 wa 1998) ("Molao"), tlhagisitse thulaganyo ya go arologanya motswedi ya metsi ka go rebola Kitsiso ya Puso ya No. ya R. 810, e e phasaladitsweng mo Kuranteng ya Puso ya No. ya 33541 ya letlha la 17 Lwetse 2010. Go ya ka karolo ya 16(1) ya Molao, Tona o tshwanetse, ka bonako jo bo matshwanedi morago ga karologanyo ya motswedi otlhe wa metsi kgotsa karolo ya ona e setse e tlhomamisitswe, ka Kitsiso mo Kuranteng, go tlhomamisa resefe go motswedi otlhe wa metsi kgotsa karolo ya ona.
- 2.3 Tona, go ya ka karolo ya 16(1) le ya (2) ya Molao, o kaya Diresefe tse di latelang mabapi le madutelo a Bophirima jwa Crocodile le Marico.

3. TLHOMAMISO YA RESEFE E E TSHITSHINTSWENG JAAKA GO TLHOKEGA GO YA KA KAROLO YA 16(1) LE YA (2) YA MOLAO WA BOSETŠHABA WA METSI WA 1998

Tshobokanyo ya karolo ya bogolo mabapi le Dinoka tse di akaretsang EWR (**Setshwantsho sa 1**) le BHN go ya ka karolo ya 16(1) ya Molao mabapi le bodutelo jwa (Bophirima) Crocodile le jwa Marico e tlhagisiwa mo Karolong ya 4. **Thulaganyo ya 4.1& 4.2** e akaretsa dipholo tsa mafelo a EWR le dikopano tsa bayofisikale;

Tshobokanyo ya karolo ya boleng mabapi le Noka kwa mafelong a EWR go ya ka karolo ya 16(1) ya Molao mabapi le bodutelo jwa (Bophirima) jwa Crocodile le jwa Marico e tlhagisiwa mo **Thulaganyong ya 5.1-5.24**;

Tshobokanyo ya seatse sa metsi a ka fa tlase ga lefatshe go Resefe mabapi le Bontsi jwa Metsi go ya ka karolo ya 16(1) ya Molao mabapi le bodutelo jwa (Bophirima) jwa Crocodile le jwa Marico e tlhagisiwa mo **Thulaganyong ya 6.1**;

Tshobokanyo ya seabe sa metsi a ka fa tlase ga lefatshe go Resefe mabapi le Boleng jwa Metsi go ya ka karolo ya 16(1) ya Molao mabapi le bodutelo jwa (Bophirima) jwa Crocodile le jwa Marico e tlhagisiwa mo **Thulaganyong ya 7.1, 7.2 le 7.3**;

Resefe e tla dira go simolola ka letlha le le kailweng jaaka go tlhomamisitswe go ya ka Karolo ya 16(1) ya Molao, ntle le fa go totobaditswe ke Tona ka mokgwa mongwe.

4. METSI A MO BOALONG - KAROLO YA BONTSI MABAPI LE DINOKA

Dipholo tse di tshitshintsweng mabapi le tlhomamiso ya Resefe le karologanyo ya ekholoji mabapi le bodutelo jwa (Bophirima) jwa Crocodile le jwa Marico, mo bokanakang jwa Resefe bo tlhagisiwa e le peresente ya NMAR mabapi le madutelo a a rileng (ka botlalo) go ya ka karolo ya (16)(1).

Thulaganyo ya 4.1: Tshobokanyo ya karolo ya bontsi mabapi le Dinoka tse di akaretsang EWR & BHN mabapi le mafelo a a bothokwa.

Leina la Kopano	Botutelo jwa Kwatenari	Leina la Noka	PES	EIS	Karolo e Atanegisitsweng ya Ekholoji e tshwanetseng go thokomelwa	NIMAR (MCM) ¹	EWR % NIMAR ²	Resefe ya BHN (%NIMAR) ³	Resefe ya Botlalo (%NIMAR) ⁴
Lefelo la EWR Croc_EWR1	A21 H	Noka ya Crocodile go tswa mo dikgathong tsa Jukskei go tshela Harbeespoort Dam	D	Bogareng	D	231.05	24.07	0.17	24.24
Lefelo la EWR Croc_EWR2	A21C	Noka ya Jukskei	E	Bogareng	D	139.9	29.19	3.55	32.74
Lefelo la EWR Croc_EWR3	A21J	Crocodile go tswa go Harbeespoort Dam go tshatloga le Roodekopjes Dam	C/D	Godimo	C/D	143.3	25.02	0.84	25.87
Lefelo la EWR Croc_EWR4	A23B	Plenaars go tswa go Roodepiaat Dam botso jwa bodutelo jwa kwatenari	C	Godimo	C	28.2	30.81	1.18	31.99
Lefelo la EWR Croc_EWR5	A23J	Moretele (Plenaars) go dikgatho le Crocodile	D	Godimo	D	113.0	11.82	5.23	17.05
Lefelo la EWR Croc_EWR6	A22J	Hex go tswa go Bospoort Dam go tshela Vaalkop Dam	D	Bogareng	D	26.9	14.96	1.35	16.31
Mafelo a EWR Croc_EWR7	A24C	Noka ya Crocodile go tswa go Roodekopjes Dam go tshatloga le dikgatho tsa Sand Rive, Sleafontainspruit, medutela ya Klipspruit	D	Bogareng	D	463.4	13.9	0	13.9
Lefelo la EWR Croc_EWR8	A24J	Crocodile e e kwa Tlase go tswa go dikgatho tsa Bierspruit go dikgatho le Limpopo	D	Bogareng	D	565.16	7.48	0.09	7.57
Croc Rapid EWR9	A21F	Magalies kwa tlase ga Maloney's Eye	B	Bogareng	B	14.61	45.93	0.58	46.51
Rapid EWR10	A22A	Dikgala tse di kwa godimo tsa Elands (motswedi) go fitlha go Swartruggens Dam	C	Bogareng	B/C	10.1	30.48	3.66	34.14
Croc Rapid EWR11	A21K	Dikgala tse di kwa godimo tsa Sterkstroom (motswedi) go tshela Buffelspoort Dam	C	Godimo	C	13.95	28.41	5.76	34.17
Croc Rapid EWR12	A23G	Plat River	C/D	Bogareng	C/D	4.864	23.08	14.20	37.28
Croc Rapid EWR13	A22E	Elands go tswa go Lindleyspoort Dam go fitlha go Vaalkop Dam	C	Botlase	C	18.77	21.90	0.312	22.21
Croc Rapid EWR14	A22H	Waterkloofspruit go dikgatho le Hex	B/C	Botlase	B/C	5.469	28.27	38.44	66.71
Croc Rapid EWR15	A21F	Magalies, Klein Magalies, Bloubank	C/D	Botlase	C/D	21.89	21.18	0.39	21.57
Croc Rapid EWR_16	A21A	Rietvlei (motswedi)	C	Botlase	C	4.788	27.83	28.865	56.69
Lefelo la EWR Mar_EWR1	A31A	Marico Eye, Kaaloog-se-Loop, Bokkraal-se-Loop, Ribbokfontein-se-Loop, Rietsspruit (southern eye), Kullisfontein, Syferfontein, Bronkhorstfontein	B	Godimo thata	B	10.539	76.32	0	76.32
Lefelo la EWR Mar_EWR2	A31B	Bogolthe jwa Groot Marico go tshatloga le dikgatho tsa Polkadraaispruit	B	Godimo thata	B	42.08	50.26	0.03	50.29
Lefelo la EWR Mar_EWR3	A31F	Marico Groot Marico go tswa go Marico Bosveld Dam go fitlha go Molatedi Dam, medutela yothle	C/D	Godimo	C/D	65.083	23.62	0.33	23.95

Leina la Kopano	Botutelo jwa Kwatenari	Leina la Noka	PES	EIS	Karolo e e Atlanegisitweng ya Ekholoji e e tshwanetseng go tihokomelwa	NIMAR (MCHM) ¹	EWR % NIMAR ²	Resefe ya BHN (%NIMAR) ³	Resefe ya Botlalo (%NIMAR) ⁴
Lefelo la EWR Mar EWR4	A32D	Marico go tswa go Molatedi Dam go dikgatho le Limpono, noka ya Rasweu, noka ya Masejate	C	Godimo	C	153.25	7.96	0.01	7.97
Lefelo la EWR Mar EWR5	A31E	Klein Marico go tswa go Klein Maricopoort Dam go filha go Kromellemboog Dam	C	Bogareng	C	16.25	11.70	0.05	11.75
Rapid EWR6	A31B	Polkadraaispruit go dikgatho le Marico	B/C	Bogareng	B	9.87	49.27	0.13	49.39

1) NIMAR ke Go gogiwa ga Metsi ka Ngwaga ka Mokgwa wa Thago.

2) Bokanakang jo bo emela mokgwa wa pakatelele go ikaegitwe ka NIMAR. Fa NIMAR e fetoga, bokanakang jo le bona go tla fetoga.

3) Bo emela peresente ya BHN.

4) Bokanakang jofhe jwa Resefe bo emela Resefe ya Ekholoji le Resefe ya Dilithokwa tsa Motheo tsa Batho (BHN).

Thulaganyo ya 4.2: Tshobokanyo ya karolo ya bontsi mabapi le mafelo a didirisiwa tse di akaretsang EWR & BHN

Leina la Kopano	Botutelo jwa Kwatenari	Leina la Noka	PES	EIS	Karolo e e Atlanegisitweng ya Ekholoji e e tshwanetseng go tihokomelwa	NIMAR (MCHM) ¹	EWR % NIMAR ²	Resefe ya BHN (%NIMAR) ³	Resefe ya Botlalo (%NIMAR) ⁴
HN1	A21A	Noka ya Hemmops go tihallaga le Rietvlei Dam	C	Botlase	C	11.66	27.83	11.84	39.67
HN25	A22H	Hex go tswa go Olifantsnek Dam go ya go Bospoort Dam, Sandspruit	D	Bogareng	D	12.11	15.26	17.36	32.62
HN29	A22A	Elands go tswa go Swartuggens Dam go ya go Lindleyspoort Dam	C	Godimo	C	12.87	23.99	2.88	26.87
HN30	A22B	Upper Koster (motswedi) go ya go Koster Dam	C	Godimo	C	2.54	22.77	15.19	37.97
Lefelo la EWR Mar EWR2	A31B	Bogofhe jwa Groot Marico go tihallaga le dikgatho tsa Polkadraaispruit	B	Godimo thata	B	42.08	50.26	0.03	50.29
HN63	A31B	Groot Marico go tswa go dikgatho tsa Polkadraaispruit go ya go Marico Bosveld Dam	B	Godimo thata	B	56.92	50.61	0.02	50.63
HN65	A31E	Klein Marico go tswa go Zeerust go ya go Klein Maricopoort Dam	C/D	Bogareng	C/D	16.25	14.26	0.05	14.31
HN43	A24H	Sand go dikgatho le Crocodile	B	Godimo	B	26.56	27.04	1.93	28.97

1) NIMAR ke Go gogiwa ga Metsi ka Ngwaga ka Mokgwa wa Thago.

2) Bokanakang jo bo emela mokgwa wa pakatelele go ikaegitwe ka NIMAR. Fa NIMAR e fetoga, bokanakang jo le bona go tla fetoga.

3) Bo emela peresente ya BHN.

4) Bokanakang jofhe jwa Resefe bo emela Resefe ya Ekholoji le Resefe ya Dilithokwa tsa Motheo tsa Batho (BHN).

5. TSHOBOKANYO YA KAROLO YA BOLENG JWA METSI A MO BOALONG MABAPI LE DINOKA KWA MAFELONG A EWR

EWR 1: A21H-NOKA YA CROCODILE, go Tlhatloga le Hartbeespoort Dam

Thulaganyo ya 5.1: Dikarolo tsa PES le tshekatsheko ka botlalo ya lefelo mabapi le Lefelo la EWR 1

Noka	Noka ya Crocodile	Dintlha tsa Tekolo ya Boleng jwa Metsi tsa DWA
WQSU	3	RC A2H013 Noka ya Magalies kwa Scheerpoort 2002-2007 (n=205)
Lefelo la EWR	EWR1	PES A2H012 kwa Kalkheuwel mo Nokeng ya Crocodile
Dikarolo tsa Boleng jwa Metsi	Boleng	Karolo/Tshwaelo
	MgSO ₄	F(5)
	Na ₂ SO ₄	A(0)
Sesaboleng Matswat (mg/L)	MgCl ₂	A(0)
	CaCl ₂	A(0)
	NaCl	B(1)
Dinontsha (mg/L)	PO ₄	E(4)
	TIN	E(4)
Didirisiwa tse di bonagalang	pH (diyuniti tsa pH)	B(1)
	Thempereitshara (°C)	Kgodiso ka niha ya boalo jwa mantle/boalong jo bo tswetsweng
	Okosijene e e tshalogileng (mg/L)	C(2)Diraefole tse di tswetsweng
	Go tsengwa ga motlakase (mS/m)	C(2)
Sedirisiwa tsa tsibogo	Chl-a: pberiffitone (mg/m ³)	D Dikoketso tsa maatla tse di kwa godimo tsa alekale
	Tlhamago ya ditshedi tsa setshaba - sekoro sa diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)	E 4.07– 4.25
	Sekoro sa ditlhapi (FRAI)	D 44.5
	Se se mabapi le botlhole	Beke le beke go tswa mo matlakaleng ditiro tsa metsi, tse di tletseng
Tse di mabapi le	Ammonia(mg/L)	32 B(1)
Karolo ya ekholoji ya lefelo ka kakaretso (go tswa mo mmotholong wa PAI)	D	D

Thulaganyo ya 5.2: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo EWR 1: Go thhatloga le Hartbeespoort Dam

NOKA		(Bophirima) jwa Noka ya Crocodile		DINTLHA TSA TEKOLLO YA BOLENG JWA METSI	
WQSU		3		DWAQWMS	
LEFELLO LA EWR		EWR1		RHP	
Boikanyo mo tshetshetshong ya PES		Magareng		Gajaaonng mafelo a a mmalwa a tekolo	
Dikarolo tsa Boleng jwa Metsi		Karolo ya PES		Tokafatso a e a	
Matswai a a sa boleng (mg/L)		WQEsospecs		TPC	
Dinontsha (mg/L)		Tlhokomela sekga		Tekolo kgapetsakgapetsa	
MgSO ₄		>45mg/L		Boleng jwa bo95 go nna<45mg/L	
Na ₂ SO ₄		<20mg/L		Boleng jo bo kana ka 95 go nna<20mg/L	
MgCl ₂		<15mg/L		Boleng jwa bo95 go nna<15mg/L	Kgwedi le kgwedi
CaCl ₂		<21mg/L		Boleng jwa bo95 go nna<21mg/L	
NaCl		<191mg/L		Boleng jwa bo95 go nna<191mg/L	
SRP		<0.125mg/L		Boleng jwa bo50 go nna<0.125mg/L	Kgwedi le kgwedi
TIN		<4.0mg/L		Boleng jwa bo50 go nna<4.0mg/L	Kgwedi le kgwedi
pH		Boleng jwa bo5(5.9-6.5)Boeng jwa bo95 (8.0-8.8)		Boleng jwa bo5(5.9-6.5)boleng jwa bo95(8.0-8.8)	Kgwedi le kgwedi
Thempereitshara		Tlhokomela sekga		Go thagisa tekolo ya motheo mabapi le sedirisiwa.	Fa ditshekatsheko tsa bayotiki di dirwa
Okosijene e e thalogileng		7-8mg/L		Boleng jwa bo5 go nna>6.1mg/L. Go thagisa	
Tebiditi (NTU)		Sekgala se se mo magareng se se dumeletsweng		Tekolo ya motheo mabapi le sedirisiwa se. Go thagisa tekolo ya motheo mabapi le Sedirisiwa se le go thokomela sekga se se magareng.	Ka kotara
Go tsenngwa ga motlakase (mS/m)		<85mS/m		Boleng jwa bo95 go nna<85mS/m	Ka kotara
Chia: pherifone		<84mg/m ² (karolo ya D)		Boleng jwa bo50 go nna<84mg/m ²	Ka kotara
Chia: faetopolanetone		<30µg/L (karolo ya D)		Boleng jwa bo50 go nna<30µg/L	
Didirisiwa tsa tsibogo		Diphologolo tse dintsi tse di senang lerapo la mokwatla(ASPT)		Lebelela Ecospecs mabapi le dithhapi le diphologolo tse di senang lerapo la mokwatla	
		Sekoro sa setshaba sa dithhapi			
		D (thuto e)			
		Se se mabapi le bothole		Sekaseka feila fa e le gore dipholo tsa tekolo ka botlato di kaya fa go na le bothata jo bo masisi e bile sebakwa se sa itsiwe. Kutlwalo e solofetswe fa e le gore boleng jwa bo95 jwa tshedimosetso bo feila Boleng jwa Dillamorago tse di Tswelatang pele (CEV) jaaka go kaitwe mo go DWAF (1996).	
		Ammonia		Boleng jwa bo95 go nna<43.7µg/L	Kgwedi le kgwedi

EWR 2: A21C-NOKA YA JUKSKEI kwa Heron Bridge School

Thulaganyo ya 5.3: Dikarolo tsa PES le tshetshetsho ya botlalo ya lefelo mabapi le lefelo la EWR 2

Noka	Noka ya Jukskei	Dintsha tsa Tekolo ya Boleng jwa Metsi tsa DWAF	AZH013 Noka ya Magalies kwa Scheerpoort 2002-2007 (n=205)
WQSU	1	RC	
Lefelo la EWR	EWR2	PES	AZH023 Noka ya Jukskei kwa Nietgedacht 2004-2008 (n=114)
Dikarolo tsa Boleng jwa Metsi		Boleng	Karolo/Tshwaelo
	MgSO ₄	71.494	F(5)
	Na ₂ SO ₄	26.244	B(1)
Sesaboleng matsw	MgCl ₂	0.312	A(0)
	CaCl ₂	20.236	A(0)
	NaCl	96.146	B(1)
Dinonitsha(mg/L)	PO ₄	0.266	E(4)
	TIN	5.460	E(4)
Didirisiwa tse di bonagalang	pH (diyuniti tsa pH)	7.1-8.1	B(1)
	Themphereitshara (° C)	Dithemphereitshara tse di kwa godimo go tswa megobeng ya tiriso ya metsi a a maswe	D
	Okosijene e e Tlhaologileng (mg/L)	-	D
	Go tsemgwa ga Motlakase (mS/m)	63	C(2)
Sedirisiwa tsa tsibogo	Chl-a: pherifaetone (mg/m ²)	14.41	D(1)
	Tlhamego ya ditshedi tsa setshaba - sekoro sa dipholologo tse dintsi tse di senang lerapo la mokwatla (ASPT)	3.8- 4.0	E/F
	Sekoro sa ditlhapi	21.4%	E/F
Tse di mabapi le	Se se mabapi le botlhole	-	
	Ammonia (µg/L)	80	D(3)
Karolo ya ekholoji ya lefelo ka kakaretso (mmotlolo wa PAI)		D	

Thulaganyo ya 5.4: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo EWR 2: Noka ya Jukskei kwa Heron Bridge School

NOKA		DINTLHA TSA TEKOLO YA BOLENG JWA METSI	
WASU		DWAQWMS	A2H023 Noka ya Juskei kwa Nietgedacht
LEFELO LA EWR		RHP	Gajaanong mafele a a mmaliwa a tekolo
Boikanyo mo tshetshetshong ya PES			
Magareng			
Dikarolo tsa Boleng jwa Metsi			
	Karolo ya PES	WQEcospes	Tokafatso a e a
		TPC	Tekolo kgapetsakgapetsa
Matswai a a sa boleng (mg/L)	MgSO ₄	<45mg/L	Boleng jwa bo95 go nna<45mg/L
	Na ₂ SO ₄	<33mg/L	Boleng jwa bo95 go nna<33mg/L
	MgCl ₂	<15mg/L	Boleng jwa bo95 go nna<15mg/L
	CaCl ₂	<21mg/L	Boleng jwa bo95 go nna<21mg/L
Dinontsha (mg/L)	NaCl	<191mg/L	Boleng jwa bo95 go nna<191mg/L
	SRP	<0.125mg/L	Boleng jwa bo50 go nna<0.125mg/L
Se se bonagalang Didirisiwa	TiN	<4.0mg/L	Boleng jwa bo50 go nna<4.0mg/L
	pH	Boleng jwa bo5(5.9-6.5)Boeng jwa bo95 (8.0-8.8)	5 th boleng(5.9-6.5) 95 th boleng (8.0-8.8)
	Thempereitshara	Tlhokomela sekgala	Go ithagisa tekolo ya motheo mabapi le sedirisiwa.
Se se se seng sentle ka ntlha dipula tse dintsi.	Okosijene e e thaoogileng	7-8mg/L	Boleng jwa bo5 go nna>6.1mg/L. Go ithagisa
	Tebiditi (NTU)	Sekgala se se mo magareng Dumeletswe	Tekolo ya motheo mabapi le sedirisiwa se. Go ithagisa tekolo ya motheo mabapi leSedirisiwa se le go thhokomela sekgala se se magareng.
	Go tsengwa ga motlakase	<85mS/m	Boleng jwa bo95 go nna<85mS/m
	Chia: pheritone	<84mg/m ³ (karolo ya D)	Boleng jwa bo50 go nna<84mg/m ²
Didirisiwa tsa tsibogo	Chia: faetopolanketone	<15µg/L (karolo ya D)	Boleng jwa 50 go nna<15µg/L
	Diphologolo tse dintsi tse di senang lerapo la mokwatla	E/F (thuto e)	Lebelela Ecospecs mabapi le dithapi le diphologolo tse di senang lerapo la mokwatla
	Sekoro sa setshaba sa dithapi	E/F (thuto e)	
Tse di mabapi le bothole	Se se mabapi le bothole	Bothole go tswa mo ditirong tsa indaseteri le tsa tiriso ya metsi a a maswe	Sekaseka fela fa e le gore dipholo tsa tekolo ka botlalo di kaya fa go na le bothata jo bo masisi e bile sebakwa se sa itsiwe. Kutlwalo e solofetswe fa e le gore boleng jwa bo95 jwa tshedimotsetso bo feta Boleng jwa Ditlamorago tse di Tsweleng pele (CEV) jaaka go kalliwe mo go DWAF (1996).
	Ammonia	<100ug/L	Boleng jwa bo95 go nna<100ug/L

EW3: A21J-NOKA YA CROCODILE, Go theoga le Hartbeespoort Dam

Thulaganyo ya 5.5: Dikarolo tsa PES le tshekatsheko ya botlalo ya lefelo mabapi le lefelo la EWR 3

Noka	Noka ya Crocodile	Dintlha tsa Tekolo ya Boleng jwa Metsi tsa DWAF
WQSU	5	RC A2H013 Noka ya Magalies kwa Scheerpoort 2002-2007 (n=205)
Lefelo la EWR	EW3	PES A2H083 Hartbeespoort Dam: d/s Weir 2004-2008 (n=113)
Dikarolo tsa Boleng jwa Metsi		Karolo/Tshwaelo
Sesaboleng matswai (mg/L)	MgSO ₄	F(5)
	Na ₂ SO ₄	A(0)
	MgCl ₂	A(0)
	CaCl ₂	B(1)
	NaCl	B(1)
Dinontsha(mg/L)	PO ₄	E(4)
	TIN	B(1)
Didirisiwa tse di bonagalang	pH (diyuniti tsa pH)	B(1)
	Thempereitshara (°C)	C(2)
	Okosijene e e Tlhaologileng (mg/L)	C/D
	Go tsenngwa ga Motlakase (mS/m)	C(2)
Tsibogo sedirisiwa	Chl-a: pherifaetone (mg/m ²)	E
	Tlhamego ya ditshedi tsa setshaba -sekoro sa dipholologo tse dintsi tse di senang lerapo la mokwatla (ASPT)	E
	Sekoro sa dithapi	E
Tse di mabapi le bothole	Se se mabapi le bothole	
Karolo ya ekholoji ya lefelo ka kakaretso	Ammonia(mg/L)	E(4)
		D/E

EW4: A23B-NOKA YA PIENAARS, Go theoga le Roodeplaat Dam

Thulaganyo ya 5.7: Dikarolo tsa PES le tshakatsheko ya botlalo ya lefelo mabapi le lefelo la EWR 4

Noka	Noka ya Pienaars	Dintlha tsa Tekolo ya Boleng jwa Metsi tsa DWA
WQSU	15	RC A2H013 Noka ya Magalies kwa Scheerpoort 2002-2007 (r=205)
Lefelo la EWR	EW4	PES A2H006 Noka ya Pienaars kwa Klipdrift 2004-2008 (r=118)
Dikarolo tsa Boleng jwa Metsi		Karolo/Tshwaelo
Matswai a sa boleng (mg/L)	MgSO ₄	F(5)
	Na ₂ SO ₄	A(0)
	MgCl ₂	A(0)
	CaCl ₂	A(0)
	NaCl	B(1)
Dinontsha (mg/L)	PO ₄	B(1)
	TIN	A(0)
Didrisiwa tse di bonagalang	pH (diyuniti tsa pH)	B(1)
	Thempereitshara (°C)	B(1) C(2)
	Okosijene e e tshaogileng (mg/L)	
	Go tsenngwa ga motlakase (mS/m)	C(2)
Sedirisiwa tsa tsibogo	Chl-a: pherifione (mg/m ³)	Ditemogo tsa pono
	Thamego ya diitshedi tsa setshaba	
	Sekoro sa dipholologo tse dintsi tse di senang lerapo la mokwatla (ASPT)	C(2)
	Sekoro sa ditlhapi	C(2)
Tse di mabapi le Karolo ya ekholoji ya lefelo ka kakaretso	Se se mabapi le botlhole	
	Ammonia (µg/L)	A(0)
	20	
	C	

Thulaganyo ya 5.8: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo EWR 4: Noka ya Pienaars go theoga le Roodeplaatt Dam

NOKA		DINTLHA TSA TEKOLE YA BOLENG JWA METSI		
WQSU	15	DWAQWMS	A2H006 Pienaars kwa lebotakanelong la Kilpdrift	
LEFelo LA EWR	EWR4	RHP	Gajaaonng mafelo a a mmahwa a tekolo	
Boikanyo mo tshekatshekong ya PES				
Magareng				
Dikarolo tsa Boleng jwa Metsi				
Karolo ya PES		Tokafatso a e a	TPC	Tekolo kgapetsakgapetsa
Matswai a a sa boleng (mg/L)	MgSO ₄	<45mg/L	Boleng jwa bo95 go nna<45mg/L	Kgweedi le kgweedi
	Na ₂ SO ₄	<20mg/L	Boleng jo bo kana ka 95 go nna<20mg/L	
	MgCl ₂	<15mg/L	N/A	
	CaCl ₂	<21mg/L	Boleng jwa bo95 go nna<15mg/L	
	NaCl	<191mg/L	Boleng jwa bo95 go nna<21mg/L	
Dinonitsha (mg/L)	SRP	<0.015mg/L	Boleng jwa bo95 go nna<191mg/L	Kgweedi le kgweedi
	TIN	<0.25mg/L	Boleng jwa bo50 go nna<0.15mg/L	
	pH	Boleng jwa bo5(5.9-6.5)Boeng jwa bo95 (8.0-8.8)	Boleng jwa bo50 go nna<0.25mg/L	
Se se bonagalang Didirisiwa	Thempheireishara	Thokomela sekgala	5 th boleng(5.9-6.5)95 bolehg(8.0-8.8)	Kgweedi le kgweedi
	Okosijene e e thalogileng	7-8mg/L	Lefelo le a theoga go tswa kwa letamong se se la bakang go sa tsepamang ga thempheireishara kgonaagalo ya tsibogo ya bayotiki. Dihekatsheko tsa bayoloji tse di atanegisitsweng. Thagisa tekolo ya motheo.	
	Tebiditi (NTU)	Sekgala se se mo magareng Dumeletswe	Boleng jwa bo5 go nna>6.1mg/L. Go thagisa tekolo ya motheo mabapi le sedirisiwa se.	
Didirisiwa tsa tsibogo	Go tsengwa ga motlakase	Karolo ya=C	N/A	Ka kotara
	Chla: pherifone	Karolo ya =C. Thathobo ya pono e kaya dikoketso tsa maatla tse di kwa godimo tsa alekale mo matlapeng le mo megobeng	N/A	
	Chla: faetopolaniketone	C (thuto e)	N/A	
Tse di mabapi le bothole	Diphologolo tse dinisi tse di senang lerapo la mokwatla (ASPT)	Lebelela Ecospecs mabapi le dithhapi le diphologolo tse di senang lerapo la mokwatla		Kgweedi le kgweedi
	Se se mabapi le bothole	Bothole go tswa mo ditrong tsa indaseteri le tiriso ya metsi a a maswe		
	Ammonia	<15ug/L	Boleng jwa bo95 go nna<15ug/L	

EW5: A23J-NOKA YA PIENAARS, Go theoga le Klipvoor Dam kwa Phakeng ya Bosetšhaba ya Borakalalo**Thulaganyo ya 5.9: Dikarolo tsa PES le tshetshetsho ya bottalo ya lefelo mabapi le lefelo la EWR 5**

Noka	Noka ya Pienaars	Dintha tsa Tekolo ya Boleng jwa Metsi tsa DWA
WQSU	17	RC A2H013Noka ya Magalies kwa Scheerpoort2002-2007(n=205)
Lefelo la EWR	EWR5	PES A2H021 Noka ya Pienaars kwa Buffelspoort 2004-2008(n=107)
Dikarolo tsa Boleng jwa Metsi		Boleng Karolo/Tshwaelo
Matswai a a sa boleng(mg/L)	MgSO ₄	78.335 F(5)
	Na ₂ SO ₄	16.527 A(0)
	MgCl ₂	3.820 A(0)
	CaCl ₂	24.153 B(1)
	NaCl	131.982 B(1)
	PO ₄	0.598 B(1)
	TIN	0.250 A(0)
	pH(diyuniti tsa pH)	7.7-8.7 B(1)
Didirisiwa tse di bonagalang	Thempheretšhara (° C)	16(n=1)
	Okosijene e e Tlhaologileng (mg/L)	5.2(n=1)
	Go tsenngwa ga motlakase(mS/m)	80.8 C(2)
Sedirisiwa tsa tsibogo	Chl-a: pferifaetone (mg/m ²)	-
	Tlhamego ya dithedi tsa setšhaba - sekoro sa diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)	5.5 D
	Sekoro sa dithhapi (FRAI)	51.3% D
	Se se mabapi le bothole	-
Tse di mabapi le bothole	Ammonia (µg/L)	47 B(1)
	Foloraete (µg/L)	600 A(0)
Karolo ya ekholoji ya lefelo ka kakaretso		C

Thulaganyo ya 5.10: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo EWR 5: Noka ya Pienaars go theoga le Klipvoor dam

NOKA		Noka ya Pienaars		DINTLHA TSA TEKOLO YA BOLENG JWA METSI		
WQSU		17		DWAQWMS		
LEFELO LA EWR		EWR5		RHP		
Boikanyo mo tshekatshekong ya PES		Magareng		Gajaanong mafelo a a rimalwa a tekolo		
Dikarolo tsa Boleng jwa Metsi		Karolo ya PES		TPC		
		Tokafatso a e a tshokeja?		Go lekola bokgapetsakgapetsa		
		WQEcospes				
Matswai a sa boleng (mg/L)	MgSO ₄	<45mg/L			Boleng jwa bo95 go nna<45mg/L	
	Na ₂ SO ₄	<20mg/L			Boleng jo bo kana ka 95 go nna<20mg/L	
	MgCl ₂	<15mg/L	N/A		Boleng jwa bo95 go nna<15mg/L	Kgwedi le kgwedi
	CaCl ₂	<57mg/L			Boleng jwa bo95 go nna<57mg/L	
	NaCl	<191mg/L			Boleng jwa bo95 go nna<191mg/L	
Dinonisha (mg/L)	SRP	<0.015mg/L			50 th boleng go nna<0.015mg/L	Kgwedi le kgwedi
	TIN	<0.25mg/L			Boleng jwa bo50 go nna<0.25mg/L	Kgwedi le kgwedi
Didirisiwa tse di Bonagalang	pH	Boleng jwa bo5(5.9-6.5) Boleng jwa bo95(8.0-8.8)	Ee, go thago		Boleng jwa bo5(5.9-6.5) Boleng jwa bo95(8.0-8.8)	Kgwedi le kgwedi
	Thempereitshara	Tshedimoseitso e e lekanyeditsweng e bile e tholwa ke ditiro tsa tiriso ya metsi a a maswe le tiwaetisa botoropo.	N/A		Lefelo le a theoga go tswa kwa letamong se se tla bakang go se tsepame ga thempereitshara le kgonagalo ya tsibogo ya bayotiki. Dithekatsheko tsa bayotiji tse di atlanegisitweng. Thagisa tekolo ya motheo.	Fa dithshekatsheko tsa bayotiki di ditiwa
	Okosijene e e thalogileng	7-8mg/L	N/A		Boleng jwa bo5 go nna>6.1mg/L. Go thagisa Tekolo ya motheo mabapi le sedirisiwa se.	
Go tsemngwa ga motlakase (mS/m)	Tabiditi (NTU)	Sekgala se se mo magareng se se	N/A		Go thagisa tekolo ya motheo mabapi le Sedirisiwa se le go thokomela sekgala se se magareng.	Ka kotara
	Chla: pherifione	Karolo ya=C	Nnyaa		Boleng jwa bo95 go nna<85mS/m	Ka kotara
Didirisiwa tsa tsibogo	Chla: faetopolanketone	Karolo=C. Thathlho bo ya pono e kaya dikokeiso tsa maatla tse di kwa godimo tsa alekale mo matlapeng le mo megobeng	N/A		Boleng jwa bo50 go nna<84mg/m ²	Ka kotara
	Diphologolo tse ditisi tse di senang lerapo la mokwatla (ASPT)	D (thuto e)			Boleng jwa bo50 go nna<30µg/L	
Sekoro sa setshaba sa ditlhap	D (thuto e)	Lebelela Ecospecs mabapi le ditlhap le diphologolo tse di senang lerapo la mokwatla				

Tse di mabapi le bothole	Ammonia	Boithole go tswa mo ditirong tsa indaseteri le triso ya metsi a maswe	Sekaseka fele fa e le gore dipholo tsa tekolo ka botlalo di kaya fa go na le bothata to bo masisi e bile sebakwa se sa itsiwe. Kutlwalo e solofetswe fa e le gore boleng jwa bo95 jwa tshedimosetso bo feta Boleng jwa Dillamorago tse di Tsweleng pele (CEV) jaaka go kalliwe mo go DWAF. (1996).	<43.75ug/L	Boleng jwa bo95 go nna<43.75ug/L	Kgweedi le kgwedi
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EWR 6: A22J-NOKA YA HEX, Go tlhathoga le Vaalkop Dam

Table 5.11: Dikarolo tsa PES le tshokatsheko ya botlalo ya lefelo mabapi le lefelo la EWR 6

Noka	Noka ya Hex	Dintlha tsa Tekolo ya Boleng jwa Metsi tsa DWAF
WQSU	9	AZH013 Noka ya Magalies kwa Scheerpoort 2002-2007(n=205)
Lefelo la EWR	EWR6	AZH094BospoortDam d/s lebotakganelong kwa Tweedeapoort
Dikarolo tsa Boleng jwa Metsi		Karolo/Tshwaelo
Matswai a a sa boleng(mg/L)	MgSO ₄	F(5)
	Na ₂ SO ₄	A(0)
	MgCl ₂	C(2)
	CaCl ₂	E(4)
	NaCl	B(1)
	PO ₄	E(4)
Dinontsha(mg/L)	TIN	A(0)
Didirisiwa tse di bonagalang	pH(diyuniti tsa pH)	C(2)
	Thempheletshara(°C)	C(2)
	Okosijene e e tlhaologileng (mg/L)	D(3)
Sedirisiwa tsa tsibogo	Go tsengwa ga motiakase (mS/m)	D(3)
	Chl-a: pferifitone (mg/m ²)	Ditemogo tsa pono
	Tlhamago ya ditshebi tsa setshaba- sekarolo sa diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)	E
	Sekoro sa ditlhapi (FRAI)	D
Tse di mabapi le	Se se mabapi le bothole	
	Ammonia (µg/L)	E(4)
	Foloraete (µg/L)	A(0)
Karolo ya ekholoji ya lefelo ka kakaretso		D

Thulaganyo ya 5.14: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo EWR 7: Noka ya Crocodile go tshatloga le dikgatlo le Noka ya Bierspruit

NOKA		DINTLHA TSA TEKOLO YA BOLENG JWA METSI	
(Bophirima) jwa Noka ya Crocodile		DWAQWMS	A2H060 Noka ya Crocodile kwa Nootigedacht
21		RHP	Gajaaonng mafelo a a mmaliwa a tekolo
LEFELO LA EWR			
EWR7			
Magareng			
Boikanyo mo tshetshetshong ya PES			
Dikarolo tsa Boleng jwa Metsi			
MgSO ₄		Tokafatso a e a	
Na ₂ SO ₄		WQEcospecs	
MgCl ₂		TPC	
CaCl ₂		Tekolo kgapetsakgapetsa	
NaCl			
SRP			
TIN			
pH			
Themphereitshara			
Okosijene e e tshatlogileng			
Tebidititi (NTU)			
Go tsengwa gamolakase			
Chla: pherifone			
Chla: faetopolanketone			
Diphologolo tse dinisi tse di senang lerapo la mokwatla (ASPT)			
Sekoro sa setshaba sa ditlhapi			
Se se mabapi le bothole			
Matswai a a sa boleng (mg/L)		<45mg/L	Boleng jwa bo95 go nna<45mg/L
		<20mg/L	Boleng jo bo kana ka 95 go
		<15mg/L	Boleng jwa bo95 go nna<15mg/L
		<21mg/L	Boleng jwa bo95 go nna<21mg/L
		<191mg/L	Boleng jwa bo95 go nna<191mg/L
Dinontsha (mg/L)	Karolo=E	<0.125mg/L	Boleng jwa bo50 go nna<0.125mg/L
	Karolo ya=A	<0.25mg/L	Boleng jwa bo50 go nna<0.25mg/L
	Karolo ya=B, Bonite	Boleng jwa bo5(5.9-6.5)Boeng jwa bo95 (8.0-8.8)	5 Boleng (5.9-6.5) Boleng (8.0-8.8)
Se se bonagalang Didirisiwa	Tshedimosetso e lekanyeditsweng e bile e tlholwa ke ditiro tsa tiriso ya metsi a a maswe le tlwaetsa botoropo.	Tlhokomela sekgaala	Go tlhagisa tekolo ya motheo mabapi le sedirisiwa.
	Se se seng sentle ka ntsha dipula tse dinisi.	7-8mg/L	Boleng jwa bo5 go nna>6.1mg/L. Go tlhagisa tekolo ya motheo mabapi le sedirisiwa.
		Sekgala se se mo magareng se se dumeletsweng	Go tlhagisa tekolo ya motheo mabapi le Sedirisiwa se se go tlhokomela
	Karolo=D	<85mS/m	Boleng jwa bo95 go nna<85mS/m
	Karolo ya =C. Tlhatlho ya pono e kaya dikoketso tsa maatla tse di kwa godimo tsa alekale mo matlapeng le mo megobeng	<84mg/m ² (karolo ya D)	Boleng jwa bo50 go nna<84mg/m ²
Didirisiwa tsa tsibogo	E (thuto e)	<30µg/L (karolo ya D)	Boleng jwa bo50 go nna<30µg/L
		Lebelela Ecospecs mabapi le ditlhapi le diphologolo tse di senang lerapo la mokwatla	
	D (thuto e)		
	Bothole go tswa mo ditirong tsa indaseteri le tsa tiriso ya metsi a a maswe		Sekasaka fela fa e le gore dipholo tsa tekolo ka bottlalo di kaya fa go na le bothata jo bo masisi e bile sebakwa se sa itswe. Kutlwalo e solofetswe fa e le gore boleng jwa bo95 jwa tshedimosetso bo fela Boleng jwa Dittlamrago tse di Tswelaelang pele (CEV) jaaka go kaiwe mo go DWAF (1996).

Tse di mabapi le bothhole	Ammonia	B	≤44ug/L	Ee go D	Boleng jwa bo95 go nna<44ug/L	Kgwedi le kgwedi
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EW8: A24J-NOKA YA CROCODILE, Go theoga le dikgatlho le Noka ya Bierspruit

Thulaganyo ya 5.15: Dikarolo tsa PES le tshkatsheko ya bottlalo ya lefelo mabapi le lefelo la EWR 8

Noka	Dintlha tsa Tekolo ya Boleng jwa Metsi tsa DWA
WQSU	A2H013 Noka ya Magalies kwa Scheerpoort 2002-2007 (n=205)
Lefelo la EWR	PES
Dikarolo tsa Boleng jwa Metsi	A2H116 Haakdoornrdrifts lebotakganelo la Paul HugoDam2003-2008 (n=104)
Matswai a sa boleng (mg/L)	Karolo/Tshwaelo
	113.147 F(5)
	10.358 A(0)
	2.622 A(0)
	38.530 B(1)
	180.659 B(1)
	0.107 D(3)
	0.187 A(0)
	7.7-8.6 B(1)
	1 record B(1)
	1 record
Dinontsha (mg/L)	
	91 D(3)
Didirisiwa tse di bonagalang	
	91 D(3)
	Temogo ya pono: ga go na malele
Seditrisiwa tsa tsibogo	
	4.39 C
	54.7% C/D
	-
Tse di mabapi le Karolo ya ekholoji ya lefelo ka kakaretso	
	25 B(1)
	C/D

Thulaganyo ya 5.16: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo EWR 8: Noka ya Crocodile go theoga le dikgatho le Bierspruit

NOKA		(Bophirima) jwa Noka ya Crocodile		DINTLHA TSA TEKOLO YA BOLENG JWA METSIWA		
WQSU		24		A2H116 Noka ya Crocodile kwa Haakdooringdirift go theoga le dikgatho		
LEFELO LA EWR		EWR8		RHP		
Boikanyo mo tshetshetshong ya PES		Magareng		Gajaanong mafelo a a mmalwa a tekolo		
Dikarolo tsa Boleng jwa Metsi		Karolo ya PES		TPC		
		Tokafatso a e a		Tekolo kgapetsakgapetsa		
Matswai a a sa boleng (mg/L)	MgSO ₄		<45mg/L		Boleng jwa bo95 go nna<45mg/L	
	Na ₂ SO ₄		<20mg/L		Boleng jo bo kana ka 95 go nna<20mg/L	
	MgCl ₂		<15mg/L	N/A	Boleng jwa bo95 go nna<15mg/L	Kgwedi le kgwedi
	CaCl ₂		<57mg/L		Boleng jwa bo95 go nna<57mg/L	
	NaCl		<191mg/L		Boleng jwa bo95 go nna<191mg/L	
Dinontsha (mg/L)	SRP	Karolo=D	<0.125mg/L	Ee, go C	Boleng jwa bo50 go nna<0.125mg/L	Kgwedi le kgwedi
	TIN	Karolo ya=A	<0.25mg/L		Boleng jwa bo50 go nna<0.25mg/L	Kgwedi le kgwedi
Se se bonagalang Didirisiwa	pH	Karolo ya=B, Bontle	Boleng jwa bo5(5.9-6.5)Boeng jwa bo95 (8.0-8.8)	N/A	3 th Boleng (5.9-6.5) 4 th Boleng(6.0-8.8)	Kgwedi le kgwedi
	Thempereitshara	Tshedimosetso e e lekanyeditsweng e bile e tsholwa ke ditiro tsa tiriso ya metsi a a maswe le tswaetsa botoropo.	Tlhokomela sekgala	N/A	Go thagisa tekolo ya motheo mabapi le sedirisiwa.	Fa ditshetshetsho tsa bayotiki di dinwa
	Okosijene e e tshalogileng		7-8mg/L	N/A	Boleng jwa bo5 go nna>6.1mg/L. Go thagisa Tekolo ya motheo mabapi le sedirisiwa se.	
Didirisiwa tsa tsibogo	Tebiditi (NTU)	Se se seng sentle ka ntsha dipula tse dintsi.	Sekgala se se mo magareng se se dumalelsweng	N/A	Go thagisa tekolo ya motheo mabapi le Sedirisiwa se le go tlhokomela sekgala se se magareng.	Ka kotara
	Go tsenngwa ga motlakase	Karolo=D	<85mS/m	Ee, go C	Bdng jwa bo95 go nna<85mS/m	Ka kotara
	Chla: pherifone	Karolo=C. Thatlho bo ya pono e kaya dikoketso tsa maatla tse di kwa godimo tsa alekale mo matlapeng le mo megobeng	<84mg/m ² (karolo ya D)	N/A	Boleng jwa bo50 go nna<84mg/m ²	Ka kotara
	Chla: faetopolanketone		<30ug/L (karolo ya D)		Boleng jwa bo50 go nna<30ug/L	
Tse di mabapi le bothole	Diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)	E (thuto e)	Lebelela Ecospecs mabapi le ditlhapo tse di dipologolo tse di senang lerapo la mokwatla			
	Sekoro sa setshaba sa ditlhapo	C/D (thuto e)				
	Se se mabapi le bothole	B	Sekaseka fele fa e le gore dipholo tsa tekolo ka botlalo di kaya fa go na le boithata jo bo masisi e bile sebakwa se sa itsiwe. Kutlwalo e solofetswe fa e le gore boleng jwa bo95 jwa tshedimosetso bo fele Boleng jwa Ditlamorago tse di Tsweleng pele (CEV) jaaka go kailwe mo go DWAF (1996).	Ee go D	Boleng jwa bo95 go nna<44ug/L	Kgwedi le kgwedi

MAR EWR1: A31A-Kaaloog se Loop, kwa tlase ga pharagathiha, pele ga dikgatliho le Noka ya Marico

Thalaganyo ya 5.17: Dikarolo tsa PES le tshakatsheko ya botlalo ya lefelo mabapi le lefelo la Mar EWR 1

Noka	Kaaloog se Loop	Dintlha tsa Tekolo ya Boleng	
WQSU	1	RC	A2H036 Steenbokfontein mo Nokeng ya Koster 2003-2007 (n=97)
Lefelo la EWR	MAR EWR 1	PES	188041 Rietspruit kwa Bridge mo Kaaloog se Loop 2004-2008 (n=9)
Dikarolo tsa Boleng jwa Metsi		Boleng jwa RC	Karolo/Tshwaelo
Matswai a a sa boleng(mg/L)	MgSO ₄	14.765	Tshedimoseiso e e sa lekanang mabapi le go tsamaisa TEACHA sentle. EC e ka dirisiwa jaaka sesupo sa matswai a a sa boleng mabapi le PAI
	Na ₂ SO ₄	0	
	MgCl ₂	3.015	
	CaCl ₂	4.978	
	NaCl	8.717	
Dinontsha(mg/L)	PO ₄	0.016	B(1)
	TIN	0.090	A(0)
Didirisiwa tse di bonagalang	pH(5 th -95 th %)	7.32-7.98	B(1)
	Thempereitšhara (°C)	9.95-19.44	A/B(0.5)
	Okosijene e e Tlhaologileng (mg/L)	4.65-13.32	A/B(0.5)
	Go tsenngwa ga motlakase (mS/m)	16.58	B(1)
Sedirisiwa tsa tsibogo	Chl-a: pherifaetone (mg/m2)		
	Diphologolo tse dintsi tse di senang lerapo la mokwatla	5.8	A/B
	Sekoro sa setšhaba sa dithhapi	86.3	B
	Se se mabapi le bothole		
Tse di mabapi le bothole	Ammonia (µg/L)	0.003	A(0)
	Foloraete (µg/L)	0.20	B(1)
Karolo ya ekholoji ya lefelo ka kakaretso			A/B

Thulaganyo ya 5.18: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo MAR EWR 1 Noka ya Kaaloog se Loop

NOKA		Noka ya Kaaloog se Loop		DINTLHA TSA TEKOLE YA BOLENG JWA METSI	
WGSU		1		188041 Rietspruit kwa leborogong mo Kaaloog se Loop	
LEFELO LA EWR		EWR1		DWAWQWMS	
Boikanyo mo tshokatshekong ya PES		Botlase		RHP	
Dikarolo tsa Boleng jwa Metsi		Karolo ya PES		Tokafatso a e a	
Matswai a a sa boleng (mg/L)		Tshedimosetso e e sa lekanteng mabapi le go tsamaisa TEACHA sentle. EC e ka dirisiwa jaaka sesupo sa matswai a a sa boleng mabapi le PAI		WQEcospes	
Dinontsha (mg/L)		Karolo ya=B		TPC	
Se se bonagalang		Karolo ya=A		Tokolo kgapetsakgapetsa	
Didirisiwa		Noka e e mo magareng		Kgweedi le kgweedi	
Thempheireitshara		Tshedimosetso e e lekanyeditsweng e bile ga e amiwe mabapi le go thathoga		Kgweedi le kgweedi	
Okosijene e e thaaologileng		Tebiti mogara ga dipua tse dintsi ka ntlha ya tsa morero wa moepo wa seleti go thathoga		Kgweedi le kgweedi	
Tebiditi (NTU)		Go tsenngwa ga motlakase (mS/m)		Kgweedi le kgweedi	
Chla: pherifone		Chla: faetopolanketone		Kgweedi le kgweedi	
Diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)		Sekoro sa setshaba sa ditlhapi		Kgweedi le kgweedi	
Se se mabapi le bothole		Se se mabapi le bothole		Kgweedi le kgweedi	
Ammonia		Ammonia		Kgweedi le kgweedi	
MgSO ₄				≤23mg/L	Boleng jwa bo95 go
Na ₂ SO ₄				≤33mg/L	Boleng jwa bo85 go
MgCl ₂				≤30mg/L	Boleng jwa bo95 go
CaCl ₂				≤57mg/L	Boleng jwa bo95 go
NaCl				≤191mg/L	Boleng jwa bo95 go
SRP				<0.015mg/L	Boleng jwa bo50 go
TIN				<0.75mg/L	Boleng jwa bo50 go
pH				>6.5 le <8.8	Boleng jwa bo95 go nna<8.8 le kgweedi >6.5
				N/A	Tlhokomela sekgaala sa thago
				N/A	Boleng jwa bo5 go nna>7mg/L
				N/A	Phetogo e e mo magareng e dumeletswe
				N/A	Boleng jwa bo95 go nna<55mS/m
				N/A	Boleng jwa bo50 go nna<1.7mg/m2
				N/A	Boleng jwa bo50 go nna<10µg/L
				Lebelela Ecospecs mabapi le ditlhapi le dipholologo tse di senang lerapo la mokwatla	
				Sekaseka fela fa e le gore dipholo tsa tekoto ka botlalo di kaya fa go na le bothata jo bo masisi e bile sebakwa se sa itsiwe.	
				≤15ug/L	Boleng jwa bo95 go nna<15ug/L

MAR EWR2: A31B-Noka ya Groot Marico go Tlhatloga le dikgatlho tsa Sterkstroom

Tlhalaganyo ya 5.19: Dikarolo tsa PES le tshhekatsheko ya botlalo ya lefelo mabapi le lefelo la Mar EWR 2

Noka	Groot Marico	Dintlha tsa Tekolo ya Boleng	Karolo/Tshwaelo
WQSU	1	RC	A2H036 Steenbokfontein mo Nokeng ya Koster 2003-2007 (n=97)
Lefelo la EWR	MAR EWR 2	PES	188035 Koedoesfontein mo Nokeng ya Groot-Marico 2004-2008 (n=9)
Dikarolo tsa Boleng jwa Metsi		Boleng jwa RC	Boleng jwa Karolo/Tshwaelo
Matswai a sa boleng (mg/L)	MgSO ₄	14.765	Tshedimosetso e e sa lekanang mabapi le go tsamaisa TEACHA sentle. EC e ka dirisiwa jaaka sesupo sa matswai a a sa boleng mabapi le PAI
	Na ₂ SO ₄	0	
	MgCl ₂	3.015	
	CaCl ₂	4.978	
	NaCl	8.717	
Dinontsha (mg/L)	PO ₄	0.016	0.02 B(1)
	TIN	0.090	0.11 A(0)
Didirisiwa tse di bonagalang	pH(5 th -95 th %)	7.32-7.98	8.02-8.38 B(1)
	Thempereitshara (°C)		11.95-22.65 B(1)
	Okosijene e e Tlhaologileng (mg/L)		2.09-8.83 B(1)
	Go tsenngwa ga motlakase (mS/m)	16.58	34.1 B(1)
Sedirisiwa tsa tsibogo	Chl-a: pherifaetone (mg/m ²)		
	Diphologolo tse dintsi tse di senang lerapo la mokwatta		A/B
	Sekoro sa setshaba sa ditlhapi		B
	Se se mabapi le bothole		
Tse di mabapi le Karolo ya ekholoji ya lefelo ka kakareiso	Foloraete (µg/L)	0.20	0.02 A(0)
			B

Thulaganyo ya 5.20: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo MAR EWR 2

NOKA		Marico		DINTLHA TSA TEKOLO YA BOLENG JWA METSI	
WQSU		1		188035 Koedoesfontein mo Nokeng ya Groot-Marico 2004-2008 (n=9)	
LEFELO LA EWR		MAR EWR2		RHP	
Boikanyo mo tshetatshekong ya PES		Botlase		Gajaanong mafele a a mmalwa a tekolo	
Dikarolo tsa Boleng jwa Metsi		Karolo ya PES		WQEcospes	
		Tokafatso a e a		TPC	
		Tekolo kgapetsakgapetsa			
Matswai a sa boleng (mg/L)	MgSO ₄	Tshedimosetso e e sa lekanang mabapi le go tsamaisa TEACHA sentle. EC e ka dirisiwa jaaka sesupo sa matswai a a sa boleng mabapi le PAI	≤23mg/L	Boleng jwa bo95 go	Kgwedi le kgwedi
	Na ₂ SO ₄		≤33mg/L	Boleng jwa bo95 go	Kgwedi le kgwedi
	MgCl ₂		≤30mg/L	Boleng jwa bo95 go	Kgwedi le kgwedi
	CaCl ₂		≤57mg/L	Boleng jwa bo95 go	Kgwedi le kgwedi
	NaCl		≤191mg/L	Boleng jwa bo95 go	Kgwedi le kgwedi
Dinonisha (mg/L)	SRP	Karolo ya= B	<0.015mg/L	Boleng jwa bo50 go	Kgwedi le kgwedi
	TIN	Karolo ya=A	<0.75mg/L	Boleng jwa bo50 go	Kgwedi le kgwedi
Se se bonagalang Didirisiwa	pH	Noka e e mo magareng	>6.5 le <8.8	Boleng jwa bo95 go nna<8.8 le >6.5	Kgwedi le kgwedi
	Thempheletshara	Tshedimosetso e e lekanyeditsweng ga e amiwe ke ditiro tsa go thathoga	N/A	Tlhokomela sekgala sa tlhago	Kgwedi le kgwedi
	Okosijene e e thaaogitleng		N/A	Boleng jwa bo5 go nna>7mg/L	Kgwedi le kgwedi
	Tebiditi (NTU)	Tebiti mogaro ga dipula tse dintsi ka ntha ya tsa morero wa moepo wa seleti go thathoga	N/A	Phefotogo e e mo magareng e dumeletswe	Kgwedi le kgwedi
	Go tsengwa ga motlakase (mS/m)	Karolo ya= B	≤55mS/m	Boleng jwa bo95 go nna<55mS/m	Ka kotara
Didirisiwa tsa tsibogo	Chia: pheritone	Tlathhobo ya pono e kaya go nna teng go lekanyeditsweng ga alekale mo matlapeng le ka mo megobeng	≤1.7mg/m ² (Karolo ya A)	Boleng jwa bo50 go nna<1.7mg/m ²	Ka kotara
	Chia: faetopolanketone		≤10µg/L (Karolo ya A)	Boleng jwa bo50 go nna<10µg/L	Ka kotara
	Diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)	A/B (thuto e)	Lebelela Ecospecs mabapi le ditlhapi le diphologolo tse di senang lerapo la mokwatla		
	Sekoro sa setshaba sa ditlhapi	B/C (thuto e)			
	Se se mabapi le bothole	Ga go na bothole			
Tse di mabapi le bothole	Ammonia	A	≤15ug/L	Boleng jwa bo95 go nna<15ug/L	Kgwedi le kgwedi

MAR EWR3: A31F-Noka ya Groot Marico go theoga ga Marico Bosveld Dam

Thulaganyo ya 5.21: Dikarolo tsa PES le tshakatsheko ya botlalo ya lefelo mabapi le lefelo la Mar EWR 3

Noka	Groot Marico	Dintlha tsa Tekolo ya Boleng jwa	A2H036 Steenbokfontein mo Nokeng ya Koster 2003-2007 (n=97)	
WQSU	3	RC		
Lefelo la EWR	MAR EWR 3	PES	A3H028 Riekersdam mo kanaleng ya molema go tswa go Marico-Bosveld Dam 2002-2007 (n=141)	
Dikarolo tsa Boleng jwa Metsi		Boleng jwa RC	Boleng jwa	Karolo/Tshwaelo
Matswai a a sa boleng (mg/L)		14.765	17.112	B(1)
	MgSO ₄	0	0	A(0)
	Na ₂ SO ₄	3.015	3.7	A(0)
	MgCl ₂	4.978	4.226	A(0)
	CaCl ₂	8.717	5.603	A(0)
	NaCl	0.016	0.023	C(2)
Dinonisha (mg/L)	PO ₄	0.090	0.12	B(1)
	TIN	7.32-7.98	7.795-8.445	B(1)
Didirisiwa tse di bonegalang	pH(5 th -95 th %)		12.7-24.3	B(1)
	Thempereitshara (°C)		2.29-8.33	B(1)
	Okosijene e e Tlhaogileng (mg/L)		37.3	B(1)
	Go isenngwa ga motlakase (mS/m)	16.58		
Sedirisiwa tsa tsibogo	Chi-a: pferifaetone (mg/m2)			
	Diphologolo tse dintsi tse di senang lerapo la mokwatla		5.3	C(2)
	Sekoro sa setshaba sa ditlhapi		35	D(3)
	Se se mabapi le botlhole			
Tse di mabapi le botlhole	Ammonia (µg/L)	0.003	32	B(1)
	Foloraete (µg/L)	0.20	0.2	A(0)
Karolo ya ekholoji ya lefelo ka kakaretso				B/C

Thulaganyo ya 5.22: Dikaele tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo MAR EWR 3

NOKA		Marico		DINTLHA TSA TEKOLE YA BOLENG JWA METSI	
WQSU	3	DWAWQWMS	A3H028 Riekersdam mo kanaleng ya molema go tswa go Marico-Bosveld Dam 2002-2007 (n=141)		
LEFEO LA EWR	MAR EWR3	RHP	Gajaanong mafelo a a mmalwa a tekolo		
Boikanyo mo tshetshetsehong ya PES					
Magareng					
Karolo ya PES					
Dikarolo tsa Boleng jwa Metsi		WQEsospecs	Tokafatso a e a	TPC	Tekolo kgapetsakgapetsa
Matswai a sa boleng (mg/L)	MgSO ₄	≤23mg/L		Boleng jwa bo95 go nna<23mg/L	
	Na ₂ SO ₄	≤20mg/L	N/A	Boleng jo bo kana ka 95 go	Kgwedi le kgwedi
	MgCl ₂	≤15mg/L		Boleng jwa bo95 go	
	CaCl ₂	≤21mg/L		Boleng jwa bo95 go nna<21mg/L	
	NaCl	≤45mg/L		Boleng jwa bo95 go	
Dinontsha (mg/L)	SRP	<0.015mg/L	Ee go D	Boleng jwa bo50 go nna<0.025mg/L	Kgwedi le kgwedi
	TIN	<0.75mg/L	Ee go D	Boleng jwa bo50 go	Kgwedi le kgwedi
	pH	>6.5 le <8.8	Nnyaa	Boleng jwa bo95 go nna<8.8 le >6.5	Kgwedi le kgwedi
Se se bonagatang	Thempereitshara	Tlhokomela sekgala	N/A	Tlhokomela sekgala sa tlhago	Kgwedi le kgwedi
Didirisiwa	Okosijene e e tlhagoleleng	7-8mg/L	N/A	Boleng jwa bo5 go nna>7mg/L	Kgwedi le kgwedi
	Tebiditri (NTU)	Sekgala se se mo magareng se se dumeletsweng	N/A	Phetogo e e mo magareng e dumeletswene	Kgwedi le kgwedi
	Go tseengwa ga motlakase (mS/m)	≤55mS/m	Nnyaa	Boleng jwa bo95 go nna<85mS/m	Ka kotara
	Chia: pherifone	≤84mg/m ² (karolo ya D)	N/A	Boleng jwa bo50 go nna<84mg/m ²	Ka kotara
	Chia: faetopolan ketone	≤30µg/L (karolo ya D)		Boleng jwa bo50 go nna<30µg/L	
Didirisiwa tsa tsibogo	Diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)	Lebelela Ecospecs mabapi le ditlhaipi le diphologolo tse di senang lerapo la mokwatla			
	Sekoro sa setshaba sa ditlhaipi				
	Se se mabapi le bothole	Sekaseka fela fa e le gore dipholo tsa tekolo ka bottlalo di kaya fa go na le bothata jo bo masisi e bile sebakwa se sa itsiwe.			
Tse di mabapi le bothole	Ammonia	≤43.7µg/L	Ee go D	Boleng jwa bo95 go nna<43.7µg/L	Kgwedi le kgwedi

MAR EWR4: A32D-Noka ya Groot Marico go theoga le lebotakganelo la Tswasa, kwa Lefelong la Diphologolo la Madikwe

Thulaganyo ya 5.23: Dikarolo tsa PES le tshakatsheko ya botlalo ya lefelo mabapi le lefelo la Mar EWR 4

Noka	Groot Marico	Dintsha tsa Tekolo ya Boleng jwa	AZH036 Steenbokfontein mo Nokeng ya Koster 2003-2007 (n=97)
WQSU	9	RC	
Lefelo la EWR	MAR EWR 4	PES	A3H040 Noka ya Marico kwa lebotakganelong la Mooiplaats/Tzwasa 2002-2007 (n=181)
Dikarolo tsa Boleng jwa Metsi	Boleng jwa RC	Boleng jwa	Karolo/Tshwaelo
Matswai a a sa boleng (mg/L)	14.765	32.787	D(3)
MgSO ₄	0	0	A(0)
Na ₂ SO ₄	3.015	5.949	A(0)
MgCl ₂	4.978	5.903	A(0)
CaCl ₂	8.717	8.698	A(0)
NaCl	0.016	0.018	B/C(1.5)
PO ₄	0.090	0.08	B(1)
TiN	7.32-7.98	8.025-8.524	B(1)
Didirisiwa tse di bonagalang		14.5-26.5	B(1)
pH(5 th -95 th %)		5.5-11.4	B(1)
Thempereitshara (°C)		54.2	B(1)
Okosijene e e Tlhaologileng (mg/L)	16.58		
Go tsengwa ga motlakase (mS/m)			
Sediriswa tsa tsibogo			
Chi-a: pherifaetone (mg/m ²)			
Diphologolo tse dintsi tse di senang lerapo la mokwatla		4.5	C
Sekoro sa setshaba sa ditlhapi		61.8	C/D
Se se mabapi le botlhole			
Tse di mabapi le botlhole	0.003	0.003	A(0)
Ammonia (µg/L)	0.20	0.6	A(0)
Foloraete (µg/L)			
Karolo ya ekholoji ya lefelo ka kakaretso			B

Thulaganyo ya 5.24: Dikaelo tsa boleng jwa metsi mabapi le Resefe (Ecospecs tsa Boleng) mo MAR EWR 4

NOKA		Marico		DINTLHA TSA TEKOLE YA BOLENG JWA METSI	
WGSU		9		A3H040 Noka ya Marico kwa lebotakganelong la Mooiplaats/Tzwasa 2002-2007 (n=181)	
LEFELO LA EWR		MAR EWR4		Gajaanong mafeio a a mmalwa a tekolo	
Boikanyo mo tshetshetshong ya PES		Magareng			
Dikarolo tsa Boleng jwa Metsi		Karolo ya PES		Tokafatso a e a	
		WQEcospets		TPC	
		Tekolo kgapetsakgapetsa			
Matswai a a sa boleng (mg/L)	MgSO ₄	≤15mg/L		Boleng jwa bo95 go nna<15mg/L	Kgwedi le kgwedi
	Na ₂ SO ₄	≤20mg/L	N/A	Boleng jo bo kana ka 95 go	
	MgCl ₂	≤15mg/L		Boleng jwa bo95 go	
	CaCl ₂	≤21mg/L		Boleng jwa bo95 go nna<21mg/L	
Dinontsha (mg/L)	NaCl	≤45mg/L		Boleng jwa bo95 go	
	SRP	≤0.125mg/L	Ee go D	Boleng jwa bo50 go nna<0.125mg/L	Kgwedi le kgwedi
Se se bonagalang Didirisiwa	TIN	≤0.25mg/L	Ee go D	Boleng jwa bo50 go	Kgwedi le kgwedi
	pH	>5.9 le <8.8	Nnyaa	Boleng jwa bo95 go nna<8.8 le >5.9	Kgwedi le kgwedi
Se se bonagalang Didirisiwa	Thempereitshara	Thokomela sekgala	N/A	Thokomela sekgala sa thago	Kgwedi le kgwedi
	Okosijene e e thhaologileng	7-8mg/L	N/A	Boleng jwa bo5 go nna>7mg/L	Kgwedi le kgwedi
	Tebiditi (NTU)	Sekgala se se mo magareng se se dumeletsweng	N/A	Phetogo e e mo magareng e dumeletswa	Kgwedi le kgwedi
	Go tsemngwa ga motlakase (mS/m)	≤55mS/m	Nnyaa	Boleng jwa bo95 go nna<55mS/m	Ka kotara
Didirisiwa tsa tsibogo	Chia: pferiftione	≤12mg/m ² (karolo ya B)	N/A	Boleng jwa bo50 go nna<12mg/m ²	Ka kotara
	Chia: faetopolanketone	≤15µg/L (karolo ya B)		Boleng jwa 50 go nna<15µg/L	
	Diphologolo tse dintsi tse di senang lerapo la mokwatla (ASPT)	Lebelela Ecospecs mabapi le dithapi le diphologolo tse di senang lerapo la mokwatla			
Tse di mabapi le bothole	Sekoro sa setshaba sa dithapi	C/D (thuto e)			
	Se se mabapi le bothole	Bothole jo bo lekanyeditsweng go tsa mo go tlwaetseng botoropo go go thhatlogang, mo dthirong tsa tiriso ya metsi a a maswe le go gogiwa ga metsi ka ngwaga ka mokgwa wa thhato ga temothuo			
Tse di mabapi le bothole	Ammonia	≤15µg/L		Boleng jwa bo95 go nna<15µg/L	Kgwedi le kgwedi

6. KAROLO - YA BONTSI JWA METSI A KA FA TLASE GA LEFATSHE

Thulaganyo ya 6.1: Thempoleite ya Dikgato tse di Kaelwang ke Motswedi wa Metsi a ka fa tlase ga Lefatshe (GRDM)

Bodutelo Jwa Kwatenari	Lefelo(km ²)	Go neela maatia (Mm ³ /a)	Setšhaba (Ditirelo tsa Metsi) 2011)	Kelelo ya motheo (Mm ³ /a)	MLF_EWR (Mm ³ /a)	Resefe ya BHN (Mm ³ /a)	Resefe (Mm ³ /a)	Resefe jaka % ya Go neela maatia	Tiriso ya Gajaanong ya Metsi a ka fa Tlase ga Lefatshe (Mm ³ /a)	Tshupane ya Kgatelelo
A10A	559	8.81	49366	0.00	0.35	0.45	0.80	9.08	1.37	0.16
A10B	1015	12.56	25432	0.00	0.85	0.23	1.08	8.60	1.32	0.11
A10C	271	3.58	4099	0.00	0.19	0.04	0.23	6.42	0.85	0.24
A21A	483	27.641	151332	0.54	2.51	1.38	3.89	14.08	20.35	0.74
A21B	527	30.215	758882	0.32	1.60	6.92	8.52	28.21	11.58	0.38
A21C	761	18.684	545170	1.04	5.90	4.97	10.87	58.20	1.17	0.06
A21D	372	19.655	210207	1.51	4.20	1.92	6.12	31.13	11.53	0.59
A21E	290	9.207	15659	0.41	2.49	0.14	2.63	28.60	0.77	0.08
A21F	1,000	47.399	9362	1.26	3.10	0.09	3.19	6.72	33.62	0.71
A21G	161	6.238	110652	1.74	5.23	1.01	6.24	100.03	0.49	0.08
A21H	514	20.892	45327	2.56	3.67	0.41	4.08	19.55	3.23	0.15
A21J	1,150	29.893	133204	0.29	2.02	1.22	3.24	10.82	14.10	0.47
A21K	864	23.279	88100	1.51	2.87	0.80	3.67	15.78	13.54	0.58
A21L	213	4.497	43	0.16	0.19	0.00	0.19	4.23	0.61	0.14
A22A	706	21.318	40641	0.35	1.20	0.37	1.57	7.37	1.87	0.09
A22B	284	9.365	40288	0.19	0.66	0.37	1.03	10.97	1.80	0.19
A22C	515	17.303	40288	0.00	1.30	0.37	1.67	9.64	1.03	0.06
A22D	541	14.177	40288	0.10	0.60	0.37	0.97	6.83	4.02	0.28
A22E	812	19.386	6427	0.16	1.41	0.06	1.47	7.58	1.90	0.10
A22F	1,688	35.691	130476	0.95	2.25	1.19	3.44	9.64	4.02	0.11
A22G	499	17.989	846	0.35	1.00	0.01	1.01	5.60	1.46	0.08
A22H	579	15.612	230416	0.06	0.36	2.10	2.46	15.77	6.16	0.39
A22J	592	8.518	39935	0.22	0.81	0.36	1.17	13.79	2.20	0.26
A23A	682	28.30	391615	13.45	4.10	3.57	7.67	27.10	12.77	0.45
A23B	814	10.502	36522	0.28	2.00	0.33	2.33	22.22	1.45	0.14
A23C	491	6.2	2308	0.10	0.74	0.02	0.76	12.28	0.79	0.13
A23D	252	18.726	125166	1.77	2.43	1.14	3.57	19.08	13.73	0.73
A23E	490	6.28	75096	0.06	1.51	0.69	2.20	34.96	3.10	0.49
A23F	565	6.476	361907	0.28	0.69	3.30	3.99	61.65	0.74	0.11
A23G	951	20.58	75670	0.82	0.82	0.69	1.51	7.34	10.89	0.53
A23H	1,058	28.124	14570	0.13	2.20	0.13	2.33	8.30	2.59	0.09
A23J	930	6.782	647955	0.82	1.56	5.91	7.47	110.18	0.43	0.06
A23K	1,131	10.964	452332	0.13	1.20	4.13	5.33	48.59	0.50	0.05
A23L	329	3.074	4423	0.35	0.60	0.04	0.64	20.83	0.62	0.20

Bodutelo jwa Kwatenani	Lefelo(km ²)	Go neela maatia (Mm3/a)	Setšhaba (Ditirelo tsa Metsi) 2011)	Kelelo ya motheo (Mm3/a)	MLF_EWR (Mm ³ /a)	Resefe ya BHN (Mm3/a)	Resefe (Mm3/a)	Resefe jaka % ya Go neela maatia	Tiriso ya Gajaanong ya Metsi a a ka fa Tlase ga Lefatshe (Mm3/a)	Tshupane ya Kgatelelo
A24A	493	5.73	8153	0.92	0.95	0.07	1.02	17.88	2.91	0.51
A24B	709	18.594	732	0.22	1.10	0.01	1.11	5.95	1.05	0.06
A24C	801	20.297	25539	0.13	0.07	0.23	0.30	1.49	11.18	0.55
A24D	1,327	20.547	50853	0.00	1.43	0.46	1.89	9.22	1.46	0.07
A24E	688	10.585	42926	0.00	0.73	0.39	1.12	10.60	0.01	0.00
A24F	591	12.09	25539	0.00	0.68	0.23	0.91	7.55	6.04	0.50
A24G	735	24.662	25539	0.35	2.12	0.23	2.35	9.54	0.36	0.01
A24H	1,338	37.309	56281	1.86	1.35	0.51	1.86	4.99	4.21	0.11
A24J	2,516	35.192	3778	0.60	1.71	0.03	1.74	4.96	39.50	1.12
A31A	632	16.878	9106	6.00	1.83	0.08	1.91	11.33	3.64	0.22
A31B	596	15.928	1390	6.00	3.02	0.01	3.03	19.04	2.68	0.17
A31C	485	15.045	2597	1.00	0.32	0.02	0.34	2.28	3.77	0.25
A31D	704	20.906	15615	1.00	0.55	0.14	0.69	3.31	3.42	0.16
A31E	601	17.336	936	2.00	1.25	0.01	1.26	7.26	0.81	0.05
A31F	702	22.388	24060	2.00	0.90	0.22	1.12	5.00	2.13	0.10
A31G	1,425	24.094	46990	4.00	3.17	0.43	3.60	14.94	0.67	0.03
A31H	684	15.299	32553	0.00	0.64	0.30	0.94	6.12	0.45	0.03
A31J	844	18.52	536	0.00	0.31	0.00	0.31	1.70	0.27	0.01
A32A	472	5.425	9952	0.00	0.18	0.09	0.27	4.99	0.04	0.01
A32B	641	14.587	5439	0.00	0.47	0.05	0.52	3.56	0.05	0.00
A32C	902	17.582	77	0.00	0.59	0.00	0.59	3.36	0.00	0.00
A32D	843	14.373	1538	0.00	0.59	0.01	0.60	4.20	0.13	0.01
A32E	2,499	15.775	2776	0.00	1.66	0.03	1.69	10.68	0.60	0.04

7. KAROLO - YA BOLENG JWA METSI A KA FA TLASE GA LEFATSHE

Boleng jwa metsi a ka fa tlase ga lefatshe ka bodutelo jwa kwatenari bo ne jwa tlhomamisiwa go tswa mo diseteng tsa tshedimose tse di neng tsa bonwa kwa Thulaganyong ya T samaiso ya Metsi ya Lefapha la Metsi le Kgeleloleswe. Boleng jwa metsi a ka fa tlase ga lefatshe bo ne jwa tlhalosiwa ke dikaelo tsa boleng jwa metsi mo Thulaganyong ya 7.1 fa tlase.

Thulaganyo ya 7.1: Dikaelo tsa Boleng jwa Metsi

Bontsi jwa Khemikhale	Dikgala tsa Boleng jwa Metsi tsa Setotiwa ¹			
	Setlhophsa sa 0	Setlhophsa sa I	Setlhophsa sa II	Setlhophsa sa III
pH	6 – 9	5 – 6 & 9 – 9.5	4 – 5 & 9.5 – 10	<4 & > 10
Go tsenngwa ga motlakase	< 70	70 - 150	150 – 370	> 370
Khalesiamo jaaka Ca	< 80	80 - 150	150 – 300	> 300
Makenesiamo jaaka Mg	< 70	70 - 100	100 – 200	> 200
Sodiamo jaaka Na	< 100	100 - 200	200 – 400	> 400
Teloraete jaaka Cl	< 100	100 - 200	200 – 600	> 600
Salefeite jaaka SO ₄	< 200	200 - 400	400 – 600	> 600
Naetereite jaaka NO _x -N	< 6	6 - 10	10 – 20	> 20
Foloraete jaaka F	<0.7	0.7 – 1.0	1.0 – 1.5	> 1.5

1) Ref: Quality Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed. 1996. Water Research Commission Report No. TT 101/96. Pretoria, South Africa.

ELA TLHOKO:

Setlhophsa sa 0 Se ke boleng jwa metsi jwa maikaelelo, jo bo leng maleba go dirisiwa botshelo jotlhe, kwa ntle le ditlamorago tse di sa siamang tsa boitekanelo mo go modirisi. Setlhophsa se se tshwana thata le sekgala sa boleng jwa metsi sa setotiwa mo 2nd edition ya the South African Water Quality Guidelines for Domestic Use (DWAf, 1996).

Setlhophsa sa I Metsi mo setlhopheng se a bolokese gileng go dirisiwa botshelo jotlhe, fela a tlhabela boleng jwa metsi jwa maikaelelo ka gone go ka tswa go na le dintlha tsa ditlamorago tse di sa siamang tsa boitekanelo, fela tsona ka gale di ga se tse di tse neletseng, e bile ditlamorago tsa boitekanelo tse di sa fitlhegang ga di bonagale e bie di thata go ka supuwa. Metsi mo Setlhopheng sa I ga a bake ditlamorago tsa boitekanelo mo maemong a a siameng. Ditlamorago tse dintle di ka bonagala.

Setlhophsa sa II Metsi mo setlhopheng se a tlhalosiwa ka gore ditlamorago tsa boitekanelo tse di sa siamang ga di a tlwaelega mabapi le tiriso ya paka e khutshwane e e lekanyeditsweng. Ditlamorago tse di sa siamang tsa boitekanelo di ka nna teng thata segolobogolo ka tiriso e e tsweleng pele mo dingwageng di lw dintsi, ka tiriso ya botshelo jotlhe. Setlhophsa se se emela metsi a a maleba paka e khutshwane fela kgotsa go dirisiwa fela ka nako ya tshoganyetso, mme ga a maleba go dirisiwa ka tsweleng mo botshelong jotlhe.

Setlhophsa sa III Metsi a a na le dikarolo mo sekgaleng sa kokoanyo mo ditlamorago tse di masisi tsa boitekanelo di ka solofelwang, segolobogolo mo baneng kgotsa mo batsofeng ka tiriso ya paka e khutshwane, le ka tiriso ya paka e telele. Metsi mo setlhopheng se ga a maleba go dirisiwa jaaka metsi a a nnewang ntle le go tlhatswiwa go go lekaneng go busetsa metsi ka mo setlhopheng se se kwa tlase e bile se bolokese gile.

Thulaganyo ya 7.2: Boleng jwa Metsi a ka fa tlase ga lefatshe ka Bodutelo jwa Kwatenari

Bontsi jwa Khemikhale	Yuniti	Madutelo a Kwatenari A21A, A21B, A21C & A21D													
		Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotsa mo magareng ¹				Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshe ³				
		A21A	A21B	A21C	A21D	A21A	A21B	A21C	A21D		A21A	A21B	A21C	A21D	
pH		377	227	1510	635	7.75	7.60	6.54	7.23	5.0 – 9.5	6.98 – 8.53	6.84 – 8.36	5.89 – 7.19	6.51 – 7.95	
Go tsengwa ga motlakase	mS/m	383	227	1501	638	25.80	51.00	198.00	66.00	<150	28.38	56.10	198.00	72.60	
Khalesiamo jaaka Ca	mg/l	344	227	1294	635	25.40	47.00	198.40	59.00	<150	27.94	51.70	198.40	64.90	
Makenesiamo jaaka Mg	mg/l	344	227	1295	635	15.10	31.00	94.90	28.00	<100	16.61	34.10	100.00	30.80	
Sodiamo jaaka Na	mg/l	344	227	1294	638	3.00	10.00	87.30	25.00	<200	3.30	11.00	96.03	27.50	
Tloraete jaaka Cl	mg/l	344	227	1331	638	3.60	12.00	70.00	14.00	<200	3.96	13.20	77.00	15.40	
Salefete jaaka SO ₄	mg/l	344	227	1452	629	4.50	13.00	460.00	154.00	<400	4.95	14.30	460.00	169.40	
Naeterite jaaka NOx-N	mg/l	343	227	1316	578	0.80	2.30	71.90	2.30	<10	0.88	2.53	71.90	2.53	
Foloraete jaaka F	mg/l	344	227	520	578	0.12	0.14	0.70	0.05	<1.0	0.13	0.15	0.77	0.06	
Madutelo a Kwatenari A21E, A21F, A21G & A21H															
Bontsi jwa Khemikhale	Yuniti	Nomoro. ya Disampole								Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshe ³				
		A21E	A21F	A21G	A21H	A21E	A21F	A21G	A21H		A21E	A21F	A21G	A21H	
pH		3	307	118	7	6.70	7.58	8.24	7.90	5.0 – 9.5	6.03 – 7.37	6.82 – 8.34	7.42 – 9.06	7.11 – 8.69	
Go tsengwa ga motlakase	mS/m	3	324	126	7	20.10	25.60	37.00	47.10	<150	22.11	28.16	40.70	51.81	
Khalesiamo jaaka Ca	mg/l	3	311	116	4	10.83	25.40	39.80	27.72	<150	11.92	27.94	43.78	30.49	
Makenesiamo jaaka Mg	mg/l	3	311	116	4	4.30	15.80	24.00	22.10	<100	4.73	17.38	26.40	24.30	
Sodiamo jaaka Na	mg/l	3	311	116	4	18.10	2.50	1.00	28.76	<200	19.91	2.75	1.10	31.63	
Tloraete jaaka Cl	mg/l	3	311	116	4	19.73	1.50	3.70	12.89	<200	21.71	1.65	4.07	14.17	
Salefete jaaka SO ₄	mg/l	3	311	116	4	4.47	4.80	5.05	12.23	<400	4.91	5.28	5.56	13.45	
Naeterite jaaka NOx-N	mg/l	3	312	118	4	2.57	0.26	0.17	0.45	<10	2.82	0.29	0.19	0.49	
Foloraete jaaka F	mg/l	—	311	116	4	—	0.10	0.12	0.29	<1.0	—	0.11	0.13	0.32	

Bontsi jwa Khemikhale	Yuniti	Madutelo a Kwatenari A21J, A21K, A21L & A22A													
		Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotisa mo magareng ¹				Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatsho ³				
		A21J	A21K	A21L	A22A	A21J	A21K	A21L	A22A		A21J	A21K	A21L	A22A	
pH		150	1795	10	40	6.90	7.67	7.61	7.50	5.0 – 9.5	6.21 – 7.59	6.90 – 8.43	6.85 – 8.37	6.75 – 8.25	
Go tserngwa ga mollakase	mS/m	150	1794	10	40	179.50	330.50	31.80	32.35	<150	179.50	330.50	34.98	35.38	
Khalesiamo jaaka Ca	mg/l	142	1801	9	36	72.36	234.00	32.00	5.72	<150	79.60	234.00	35.20	6.29	
Makenesiamo jaaka Mg	mg/l	142	1801	9	36	97.98	158.00	6.10	22.43	<100	100.00	158.00	6.71	24.67	
Sodiama jaaka Na	mg/l	141	1800	9	36	125.30	256.96	23.46	17.56	<200	136.83	256.96	25.80	19.32	
Tloraete jaaka Cl	mg/l	142	1796	9	36	199.06	370.59	5.00	5.00	<200	200.00	370.59	5.50	5.50	
Salefite jaaka SO4	mg/l	141	1796	9	36	192.65	836.09	5.20	5.79	<400	211.92	836.09	5.72	6.37	
Naeterite jaaka NOx-N	mg/l	142	1770	9	36	7.29	3.05	3.75	0.31	<10	8.02	3.35	4.12	0.33	
Foloraete jaaka F	mg/l	142	1560	9	36	0.22	0.01	0.33	0.32	<1.0	0.24	0.011	0.37	0.35	
Madutelo a Kwatenari A22B, A22C, A22D & A22E															
Bontsi jwa Khemikhale	Yuniti	Nomoro. ya Disampole										Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatsho ³			
		Boleng jwa Tikologo jwa GW kgotisa mo magareng ¹				Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatsho ³								
		A22B*	A22C*	A22D*	A22E		A22B*	A22C*	A22D*	A22E					
pH		29	108	4	29	7.96	7.80	7.23	7.96	5.0 – 9.5	7.16 – 8.75	7.02 – 8.58	6.51 – 7.96	7.16 – 8.75	
Go tserngwa ga mollakase	mS/m	29	108	4	29	38.80	42.95	38.95	38.80	<150	42.68	47.25	42.84	42.68	
Khalesiamo jaaka Ca	mg/l	29	101	4	29	27.40	45.50	17.20	27.40	<150	30.14	50.05	18.92	30.14	
Makenesiamo jaaka Mg	mg/l	29	101	4	29	25.83	26.90	23.62	25.83	<100	28.42	29.59	25.99	28.42	
Sodiama jaaka Na	mg/l	29	101	4	29	6.80	4.44	13.58	6.80	<200	7.48	4.88	14.94	7.48	
Tloraete jaaka Cl	mg/l	29	101	4	29	5.00	4.10	5.25	5.00	<200	5.50	4.51	5.78	5.50	
Salefite jaaka SO4	mg/l	29	101	4	29	6.18	5.00	3.70	6.18	<400	6.80	5.50	4.07	6.80	
Naeterite jaaka NOx-N	mg/l	29	101	4	29	0.56	1.04	2.01	0.56	<10	0.61	1.15	2.21	0.61	
Foloraete jaaka F	mg/l	29	101	4	29	0.35	0.12	0.35	0.35	<1.0	0.38	0.13	0.39	0.38	

Bontsi jwa Khemikhale	Yuniti	Madutelo a Kwatenari A23E, A23F, A23G, A23H															
		Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotisa mo magareng ¹				Resefe ya BHN ²		Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshe ³					
		A23E	A23F	A23G	A23H	A23E	A23F	A23G	A23H	A23E	A23F	A23G	A23H	A23E	A23F	A23G	A23H
pH		988	6	266	68	7.66	7.32	7.93	8.47	5.0 – 9.5	6.89–8.43	6.59–8.05	7.14–8.72	7.62–8.47			
Go tsengwa ga motlakase	mS/m	988	6	255	68	90.80	69.55	65.30	56.70	<150	99.88	76.51	71.83	62.37			
Khalesiamo jaaka Ca	mg/l	988	6	255	67	82.60	41.40	24.10	53.90	<150	90.86	45.54	26.51	59.29			
Makenesiamo jaaka Mg	mg/l	988	6	258	67	51.80	35.70	6.49	28.30	<100	56.98	39.27	7.14	31.13			
Sodiama jaaka Na	mg/l	988	6	266	67	31.46	24.65	60.90	18.60	<200	34.60	27.12	66.99	20.46			
Tloraete jaaka Cl	mg/l	988	6	255	67	71.25	42.80	53.55	10.10	<200	78.38	46.86	58.91	11.11			
Salefete jaaka SO4	mg/l	988	6	258	67	109.50	19.65	8.90	5.10	<400	120.45	21.62	9.79	5.61			
Naeterite jaaka NOx-N	mg/l	988	6	266	67	5.16	5.09	0.85	2.03	<10	5.67	5.60	0.94	2.23			
Foloraete jaaka F	mg/l	988	6	258	67	0.05	0.36	0.69	0.30	<1.0	0.06	0.39	0.76	0.33			
Madutelo a Kwatenari A23J, A23K, A23L & A24A																	
Bontsi jwa Khemikhale	Yuniti	Madutelo a Kwatenari A23J, A23K, A23L & A24A															
		Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotisa mo magareng ¹				Resefe ya BHN ²		Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshe ³					
		A23J	A23K	A23L	A24A	A23J	A23K	A23L	A24A	A23J	A23K	A23L	A24A	A23J	A23K	A23L	A24A
pH		127	5	21	57	8.37	8.18	8.13	7.84	5.0 – 9.5	7.53–9.21	7.36–9.00	7.32–8.95	7.06–8.62			
Go tsengwa ga motlakase	mS/m	127	5	21	57	38.40	63.00	112.40	89.90	<150	42.24	69.30	123.64	98.89			
Khalesiamo jaaka Ca	mg/l	121	5	18	53	38.90	53.07	15.47	90.85	<150	42.79	58.38	17.02	99.94			
Makenesiamo jaaka Mg	mg/l	122	5	18	53	23.75	16.20	2.30	52.14	<100	26.13	17.82	2.53	57.36			
Sodiama jaaka Na	mg/l	122	5	18	53	2.38	52.99	215.24	19.38	<200	2.62	58.29	215.24	21.32			
Tloraete jaaka Cl	mg/l	122	5	18	53	5.00	64.79	226.96	63.96	<200	5.50	71.26	226.96	70.36			
Salefete jaaka SO4	mg/l	121	5	18	53	6.70	11.90	10.43	10.60	<400	7.37	13.09	11.47	11.66			
Naeterite jaaka NOx-N	mg/l	123	5	18	53	0.17	0.77	0.04	1.24	<10	0.18	0.85	0.05	1.37			
Foloraete jaaka F	mg/l	121	5	21	53	0.16	1.03	8.81	0.54	<1.0	0.18	1.03	8.81	0.59			

Bontsi jwa Khemikhale	Yuniti	Madutelo a Kwatenari A24B, A24C, A24D & A24E													
		Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotisa mo magareng				Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshe ³				
		A24B	A24C	A24D	A24E	A24B	A24C	A24D	A24E		A24B	A24C	A24D	A24E	
pH		36	137	24	10	7.70	7.70	8.19	7.92	5.0 – 9.5	6.93–8.47	6.93–8.47	7.37–9.01	7.13–8.71	
Go tsengwa ga motlakase	mS/m	36	137	24	10	129.15	129.00	91.25	63.00	<150	142.07	141.90	119.60	69.30	
Khalesiamo jaaka Ca	mg/l	36	139	20	8	115.50	79.50	1.96	64.10	<150	127.05	87.45	2.15	70.51	
Makenesiamo jaaka Mg	mg/l	36	139	20	8	85.50	58.00	129.85	34.65	<100	100.00	63.80	129.85	38.12	
Sodiamo jaaka Na	mg/l	36	139	20	8	77.40	90.50	5.91	26.50	<200	85.14	99.55	6.50	29.15	
Tloraete jaaka Cl	mg/l	36	139	20	8	139.30	143.10	5.25	29.79	<200	153.23	157.41	5.78	32.77	
Salefete jaaka SO ₄	mg/l	36	139	20	8	63.70	68.20	4.83	22.50	<400	70.07	75.02	5.32	24.75	
Naeterite jaaka NO _x -N	mg/l	36	139	20	8	8.63	3.75	1.98	14.95	<10	9.49	4.13	2.17	14.95	
Foloraete jaaka F	mg/l	36	139	20	8	0.81	0.84	0.10	0.25	<1.0	0.89	0.92	0.11	0.28	
Madutelo a Kwatenari A24F, A24G, A24H & A24J															
Bontsi jwa Khemikhale	Yuniti	Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotisa mo magareng				Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshe ³				
		A24F	A24G	A24H	A24J	A24F	A24G	A24H	A24J		A24F	A24G	A24H	A24J	
		pH		444	8	26	309	7.60	7.00	7.59	7.90	5.0 – 9.5	6.84–8.36	6.30–7.70	6.83–8.35
Go tsengwa ga motlakase	mS/m	435	8	26	309	297.00	45.00	76.35	102.40	<150	297.00	49.50	83.99	112.64	
Khalesiamo jaaka Ca	mg/l	434	8	26	278	152.00	41.00	44.75	62.80	<150	152.00	45.10	49.23	69.08	
Makenesiamo jaaka Mg	mg/l	433	8	26	278	115.00	4.00	32.30	58.10	<100	115.00	4.40	35.53	63.91	
Sodiamo jaaka Na	mg/l	446	8	26	278	305.00	33.00	38.60	62.80	<200	305.00	36.30	42.46	69.08	
Tloraete jaaka Cl	mg/l	434	8	26	278	825.60	10.00	29.50	85.35	<200	825.60	11.00	32.45	93.89	
Salefete jaaka SO ₄	mg/l	445	8	26	278	115.50	18.00	9.90	46.70	<400	127.05	19.80	10.89	51.37	
Naeterite jaaka NO _x -N	mg/l	336	8	26	278	3.48	0.12	0.89	5.56	<10	3.82	0.13	0.98	6.12	
Foloraete jaaka F	mg/l	392	8	26	278	0.21	3.00	0.67	0.68	<1.0	0.23	3.30	0.73	0.75	

Bontsi jwa Khemikhale	Yuniti	Madutelo a Kwatenari A31, A31B, A31C & A31D													
		Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotisa mo magareng				Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tiase ga lefatsho ³				
		A31A	A31B	A31C	A31D	A31A	A31B	A31C	A31D		A31A	A31B	A31C	A31D	
pH		75	30	480	710	8.05	7.37	7.90	8.00	5.0 – 9.5	7.25–8.86	6.63–8.11	7.11–8.69	7.20–8.80	
Go tseingwa ga motlakase	mS/m	75	30	526	758	30.50	69.75	47.40	50.90	<150	33.55	76.73	52.14	55.99	
Khalesiamo jaaka Ca	mg/l	75	25	473	695	30.54	85.27	47.60	53.50	<150	33.59	93.80	52.36	58.85	
Makenesiamo jaaka Mg	mg/l	75	25	473	697	18.20	56.80	31.25	32.17	<100	20.02	62.48	34.38	35.39	
Sodiamo jaaka Na	mg/l	75	25	473	697	3.40	17.60	2.60	3.20	<200	3.74	19.35	2.86	3.52	
Tieloraete jaaka Cl	mg/l	75	25	473	698	5.69	35.90	4.60	5.69	<200	6.26	39.49	5.06	6.26	
Salefete jaaka SO ₄	mg/l	75	25	473	697	3.00	59.33	4.50	10.10	<400	3.30	65.26	4.95	11.11	
Naeterete jaaka NO _x -N	mg/l	75	25	476	695	0.23	1.64	0.21	0.31	<10	0.25	1.81	0.23	0.35	
Foloraete jaaka F	mg/l	75	25	473	682	0.10	0.26	0.19	0.23	<1.0	0.11	0.29	0.21	0.25	
Madutelo a Kwatenari A31E, A31F, A31G & A31H															
Bontsi jwa Khemikhale	Yuniti	Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotisa mo magareng ¹				Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tiase ga lefatsho ³				
		A31E	A31F	A31G	A31H	A31E	A31F	A31G	A31H		A31E	A31F	A31G	A31H	
		pH		7	26	16	27	7.50	7.79	8.13	7.92	5.0 – 9.5	6.75–8.25	7.01–8.57	7.32–8.95
Go tseingwa ga motlakase	mS/m	7	26	16	27	17.70	74.65	41.95	76.40	<150	19.47	82.12	46.15	84.04	
Khalesiamo jaaka Ca	mg/l	7	21	13	22	14.20	18.10	20.93	44.68	<150	15.62	19.91	23.02	49.15	
Makenesiamo jaaka Mg	mg/l	7	21	13	22	10.00	15.50	35.00	23.11	<100	11.00	17.05	38.50	25.42	
Sodiamo jaaka Na	mg/l	7	21	13	22	5.80	14.70	8.55	81.63	<200	6.38	16.17	9.40	89.79	
Tieloraete jaaka Cl	mg/l	7	22	13	22	3.30	5.30	5.00	65.68	<200	3.63	5.83	5.50	72.24	
Salefete jaaka SO ₄	mg/l	7	22	13	22	2.00	9.99	3.00	10.77	<400	2.20	10.99	3.30	11.85	
Naeterete jaaka NO _x -N	mg/l	7	22	13	22	0.35	2.06	0.27	8.43	<10	0.38	2.27	0.30	9.27	
Foloraete jaaka F	mg/l	7	22	13	22	0.27	0.16	0.11	0.42	<1.0	0.30	0.18	0.12	0.46	

Bontsi jwa Khemikhale	Yuniti	Madutelo a Kwatenari A31J, A32A, A32B & A32C											
		Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotsa mo magareng ¹				Resefe ya BHN ²		Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshhe ³	
		A31J	A32A	A32B *	A32C *	A31J	A32A	A32B *	A32C *	A31J	A32A	A32B *	A32C *
pH		7	23	24	7	7.72	8.15	8.19	7.72	5.0 – 9.5	6.95–8.49	7.34–8.97	6.95–8.49
Go tsengwa ga motlakase	mS/m	7	23	24	7	76.00	90.10	91.25	76.00	<150	83.60	99.11	83.60
Khalesiamo jaaka Ca	mg/l	5	18	20	5	46.60	25.29	1.96	46.60	<150	51.26	27.82	51.26
Makenesiamo jaaka Mg	mg/l	5	18	20	5	72.10	96.40	129.85	72.10	<100	79.31	106.04	79.31
Sodiamo jaaka Na	mg/l	5	18	20	5	27.70	23.87	5.91	27.70	<200	30.47	26.25	30.47
Tloraete jaaka Cl	mg/l	6	18	20	6	4.70	25.39	5.25	4.70	<200	5.17	27.92	5.17
Salefete jaaka SO ₄	mg/l	5	18	20	5	22.40	33.30	4.83	22.40	<400	24.64	36.63	24.64
Naeterite jaaka NO _x -N	mg/l	6	18	20	6	2.53	5.77	1.98	2.53	<10	2.78	6.35	2.78
Foloraete jaaka F	mg/l	5	18	20	5	0.18	0.19	0.10	0.18	<1.0	0.20	0.21	0.20
Madutelo a Kwatenari A32D, A32E, A10A & A10B													
Bontsi jwa Khemikhale	Yuniti	Nomoro. ya Disampole				Boleng jwa Tikologo jwa GW kgotsa mo magareng ¹				Resefe ya BHN ²		Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshhe ³	
		A32D *	A32E	A10A	A10B	A32D *	A32E	A10A	A10B	A32D *	A32E	A10A	A10B
		A32D *	A32E	A10A	A10B	A32D *	A32E	A10A	A10B	A32D *	A32E	A10A	A10B
pH		24	68	503	38	8.19	8.06	7.98	7.88	5.0 – 9.5	7.37–9.01	7.25–8.87	7.09–8.67
Go tsengwa ga motlakase	mS/m	24	68	473	38	91.25	106.70	45.70	76.20	<150	119.60	117.34	83.82
Khalesiamo jaaka Ca	mg/l	20	63	435	31	1.96	64.97	49.10	45.20	<150	2.15	71.47	49.72
Makenesiamo jaaka Mg	mg/l	20	63	499	31	129.85	67.79	29.00	26.40	<100	129.85	74.57	29.04
Sodiamo jaaka Na	mg/l	20	63	499	31	5.91	66.66	2.40	56.41	<200	6.50	73.33	62.05
Tloraete jaaka Cl	mg/l	20	63	432	31	5.25	59.93	4.80	54.00	<200	5.78	65.48	59.40
Salefete jaaka SO ₄	mg/l	20	63	499	31	4.83	15.86	4.40	10.79	<400	5.32	17.45	11.87
Naeterite jaaka NO _x -N	mg/l	20	67	500	32	1.98	11.81	0.79	7.34	<10	2.17	11.81	8.08
Foloraete jaaka F	mg/l	20	63	499	31	0.10	0.41	0.10	0.40	<1.0	0.11	0.45	0.44

Bontsi jwa Khemikhale	Yuniti	Bodutelo jwa Kwatenari A10C			
		Nomoro. ya Disampole	Boleng jwa Tikologo jwa GW kgotsa mo magareng ¹	Resefe ya BHN ²	Resefe ya Boleng jwa Metsi a ka fa tlase ga lefatshe ³
		A10C	A10C		A10C
pH		22	7.96	5.0 – 9.5	7.16–8.75
Go tsenngwa ga molakase	mS/m	22	108.60	<150	119.46
Khalesiamo jaaka Ca	mg/l	17	109.10	<150	120.01
Makenesiamo jaaka Mg	mg/l	17	89.65	<100	98.62
Sodiamo jaaka Na	mg/l	17	6.53	<200	7.18
Tloraete jaaka Cl	mg/l	17	18.91	<200	20.80
Salefite jaaka SO ₄	mg/l	17	9.12	<400	10.03
Naeterite jaaka NO _x -N	mg/l	17	8.06	<10	8.86
Foloraete jaaka F	mg/l	17	0.24	<1.0	0.26

1) Go itaagijwe ka tsheditsetso e e bonwang go tswa go Akhefeng ya Bontshaba ya Metsi a ka fa tlase ga lefatshe. Boleng jo bo begiheng ke bogara jwa dipalopalo jwa bontsi bongwe le bongwe.

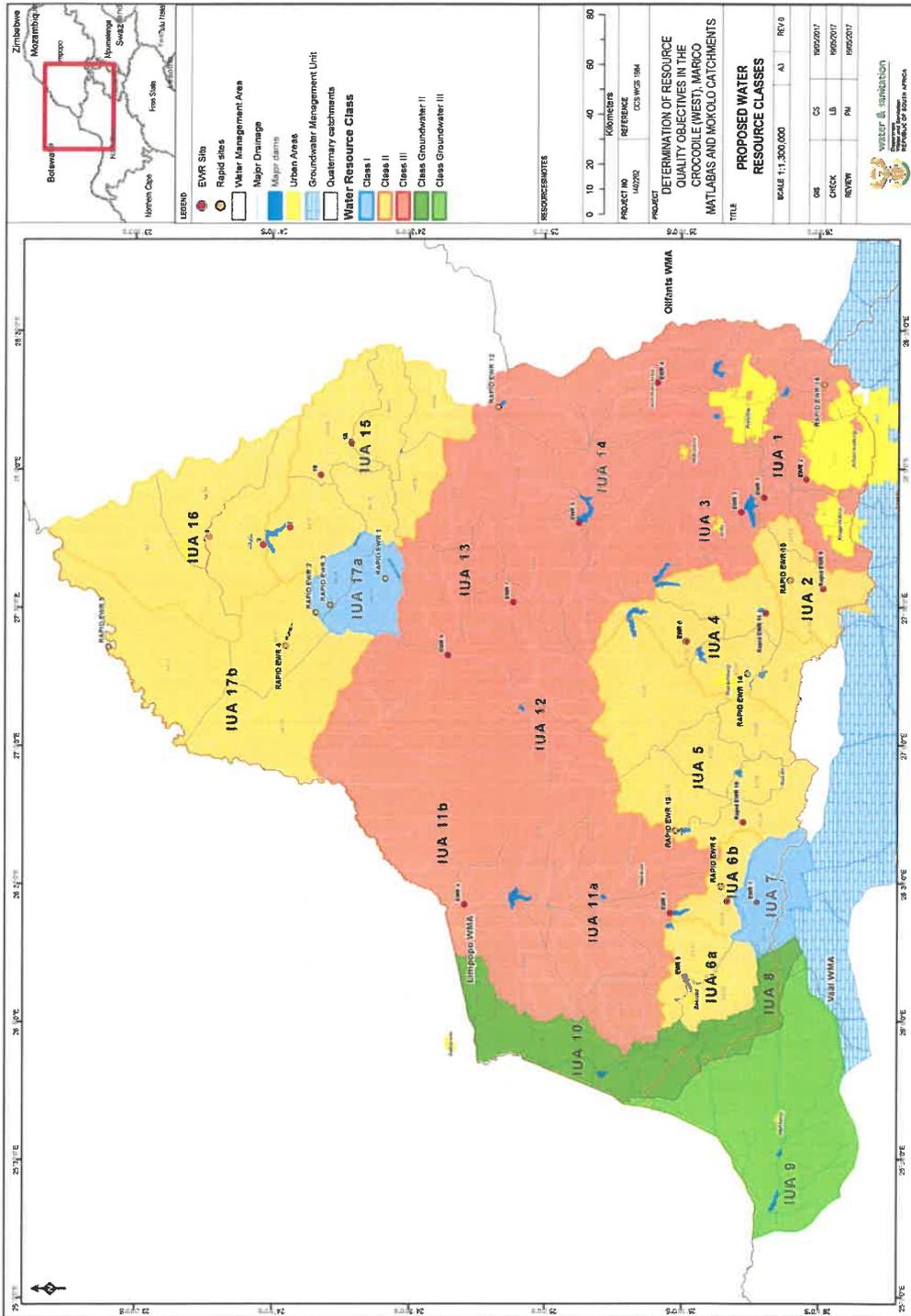
2) Ref: Quality Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed. 1998. Water Research Commission Report No. TT 101/98. Pretoria, South Africa (Self for a Class 1).

3) Mo phanongano mo difihlong tsa boleng jwa metsi a ka fa tlase ga lefatshe a tikologo le difihlong tsa motsho tsa batho a neng ya bonwa, ntsha e e kwa tlase kgopisa e e kwa godimo ya tshimolelo e no ya tshophiwa mabapi le Resefe ya boleng ya metsi a ka fa tlase ga lefatshe. Mo boleng jwa metsi a ka fa tlase ga lefatshe a tlhobogile bo no jwa tshophiwa jwa Resefe ya boleng ya metsi a ka fa tlase ga lefatshe, ntsha e no ya oketsewe ka dipensente di le 10 ntle le fa tlase ga lefatshe, ntsha e no ya oketsewe ka dipensente di le 10 ntle le fa tlase ga lefatshe.

Palogotlhe ya madutelo a le 6 a kwatenari ga a na tsheditsetso ya khemisteri ya metsi a ka fa tlase ga lefatshe, e bile a bontshitswe ka bohobidu mo Thulaganyong ya 7.2 fa godimo. Boleng jwa metsi a ka fa tlase ga lefatshe a tikologo bo ne jwa balelwa go tswa kwa madutelong a kwatenari a boagisani ka jeoloji e tshwanang ka gone jeoloji e botlhokwa thata mo boleng jwa metsi jwa lefelo.

Thulaganyo ya 7.3: Tshobokanyo ya setlhopha sa boleng jwa metsi le bontsi jo bo amegang

Bodutelo jwa kwatenari	Setlhopha sa Boleng jwa Metsi (WRC, 1998)	Bontsi jo bo amegang jwa boleng jwa metsi
A10A	0	Ga go sepe
A10B	I	Ga go sepe
A10C	I	Khalesiamo, Go tseengwa ga Motlakase, Makenesiamo, Naetereite
A21A	0	Ga go sepe
A21B	0	Ga go sepe
A21C	III	Khalesiamo, Go tseengwa ga Motlakase, Makenesiamo, Naetereite, Salefeite
A21D	0	Ga go sepe
A21E	0	Ga go sepe
A21F	0	Ga go sepe
A21G	0	Ga go sepe
A21H	0	Ga go sepe
A21J	I	Sodiamo, Makenesiamo, Tieloraete, Naetereite, Go tseengwa ga Motlakase
A21K	III	Salefeite, Khalesiamo, Makenesiamo, Sodiamo, Tieloraete, Go tseengwa ga Motlakase
A21L	0	Ga go sepe
A22A	0	Ga go sepe
A22B	0	Ga go sepe
A22C	0	Ga go sepe
A22D	0	Ga go sepe
A22E	0	Ga go sepe
A22F	0	Ga go sepe
A22G	0	Ga go sepe
A22H	III	Salefeite, Go tseengwa ga Motlakase, Khalesiamo, Makenesiamo, Sodiamo, Tieloraete,
A22J	I	Go tseengwa ga Motlakase, Naetereite
A23A	0	Ga go sepe
A23B	0	Ga go sepe
A23C	II	Tieloraete, Go tseengwa ga Motlakase, Foloraete, Naetereite, Sodiamo
A23D	0	Ga go sepe
A23E	I	Khalesiamo, Go tseengwa ga Motlakase
A23F	0	Ga go sepe
A23G	0	Ga go sepe
A23H	0	Ga go sepe
A23J	0	Ga go sepe
A23K	II	Foloraete
A23L	III	Foloraete, Sodiamo, Tieloraete
A24A	I	Khalesiamo, Go tseengwa ga Motlakase
A24B	I	Go tseengwa ga Motlakase, Khalesiamo, Makenesiamo, Sodiamo, Tieloraete
A24C	I	Tieloraete, Foloraete, Go tseengwa ga Motlakase
A24D	I	Makenesiamo, Go tseengwa ga Motlakase
A24E	0	Ga go sepe
A24F	III	Tieloraete, Go tseengwa ga Motlakase, Sodiamo, Makenesiamo, Khalesiamo
A24G	0	Ga go sepe
A24H	I	Go tseengwa ga motlakase
A24J	I	Go tseengwa ga motlakase
A31A	0	Ga go sepe
A31B	I	Calcium
A31C	0	Ga go sepe
A31D	0	Ga go sepe
A31E	0	Ga go sepe
A31F	I	Go tseengwa ga motlakase
A31G	0	Ga go sepe
A31H	I	Go tseengwa ga Motlakase, Naetereite
A31J	I	Makenesiamo, Go tseengwa ga Motlakase
A32A	I	Makenesiamo, Go tseengwa ga Motlakase
A32B	I	Makenesiamo, Go tseengwa ga Motlakase
A32C	I	Makenesiamo, Go tseengwa ga Motlakase
A32D	I	Makenesiamo, Go tseengwa ga Motlakase
A32E	II	Naetereite



Setshwantsho sa 1: Mmepe wa lefelo wa madutelo a (Bophirima) jwa Crocodile, Marico